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VOL. XIV. NEW YORK, NOV. 9, 1889. No. 19.

Electricity in Medicine. DR. M. ALLEN STARR has an able article in *Scribner's Magazine* for the current month on "Electricity in Relation to the Human Body." It is one of those explanations of a difficult subject that the public may read with great profit and benefit. At the same time, the statement in it that electrical execution is "more certain, more sudden and less offensive to spectators than that of hanging" is the purest assumption. No electrical execution has yet taken place, and there is no evidence that any human death from electricity has ever yet occurred without either torture or mutilation.

Government Telegraph Rates. THE dispute between the Postmaster General and the telegraph companies as to the rate that shall be allowed for government messages has been ended by an unconditional surrender on the part of Mr. Wanamaker. We publish this week the new rates, which, it will be seen, are very different from the one mill per word rate that was coolly proposed at the beginning. Even now the rates are not liberal, nor even just, but there is some satisfaction in seeing them approximate more nearly to the actual cost of the service.

Submarine Cable Work. AN interesting little article will be found in our columns this week in regard to the manner in which the Direct United States Cable, as it lands at Rye Beach, runs through a submerged forest, whose existence was only revealed by recent storms that denuded the beach of its sand. Not the least important part of cable work is that of making a good landing, and often the positions that offer apparent advantages are found to have hidden perils. In the present instance, however, it is not likely that the cable will suffer, though of course it would be preferable to have the cable clear of big hard stumps such as those shown.

Regulating Accumulators. ONE of the most interesting papers in the department of storage batteries which has thus far been presented to the American Institute of Electrical Engineers was that read by Mr. George B. Prescott, Jr., at its last meeting, and which we print in full in this issue. The point made by Mr. Prescott, that the success or failure of the storage battery is mainly a question of regulation, is a most true one, and it may fairly be claimed that the early failures recorded were due more to disregard of the ordinary rules than to any inherent defect in the battery itself. Its characteristics being known, it is, therefore, merely a matter of employing suitable means for avoiding undue strains and irregularities in the action of the cell. The various ways in which this may be effected are very clearly pointed out by Mr. Prescott, and every student of this subject will appreciate the valuable information which Mr. Prescott has embodied in his paper in such a clear and attractive manner.

Electric Balances. THE constancy of the force of gravity very early attracted the attention of physicists as a standard for the measurement of the electric current, and Becquerel was one of the first to construct an "electric balance," which resembled very closely the ordinary chemical balance. The difficulty attaching to this and later instruments consisted evidently in the obstacles encountered in leading the current to the weighing coils. After many attempts, Sir Wm. Thomson succeeded a short time ago in overcoming this by the employment of a ligature suspension. Excellent as this method no doubt is, it is strange that Sir William should have overlooked another method which has now been applied by Professor Blyth in a current-weighing instrument, and that is the torsion balance suspension. The torsion balance as a weighing instrument has been shown to be sensitive and delicate, and if the currents are kept sufficiently low to prevent heating in the suspension wires, the instrument ought to be reliable, and at the same time allow of cheap construction.

Profitable Electric Railways. THE Cincinnati *Commercial Gazette* contained the following in a recent issue: "For the information of a misinformed public, the *Financier* calls attention to the fact that after trying electricity for a number of years, Richmond, Va., has gone back to the old method of horse locomotion. From San Francisco papers it is learned that at Los Angeles, where electricity has been given a thorough trial, the roads are being restored to the horse and the cable. In financial circles the electric road is not yet regarded as a paying investment." It is needless to say that this statement is all wrong. Richmond has not gone back to horses, and Los Angeles has not yet fallen hopelessly from grace. Even if there were a dozen instances of failure, they would not offset the 200 successes of the past two years, nor hinder the bankers of the country everywhere from giving electric railroads their hearty support. We speak with knowledge and authority when we say that the stocks and bonds of electric roads are to-day among the most popular and profitable forms of investment, and that many of the roads recently taken over by New York and Boston bankers are paying magnificently.

One Kind of Electric Shock. IN some of the smaller towns retired merchants lie awake at night wondering how best to invest their capital so as to secure the highest returns with the least risk. In the same town a sleepy one horse street car system is allowed to vegetate, the running expenses of which are light, and ofttimes the receipts are lighter, for the local capitalist will not ride at such a slow gait, and wonders that any one else does. Buy the line and introduce a system of rapid transit? Not much. Like a sensible man he invests in corner lots in far off Boomville. Suddenly this old capitalist is shocked by the news that a syndicate of Chicago capitalists have actually bought up the road and all thereto pertaining; have contracted for the installation of an electric system of rapid transit; have increased the capital stock, bonded the road and sold the bonds; all before he recovered from his surprise at his own stupidity in allowing such a golden opportunity to slip from his grasp for the investment of his entire capital at his own hearthstone. George H. Bliss, of Chicago, recently visited a western town and endeavored to persuade local capital to take hold of a railway line, and finally had to secure outside capital. Now that it is too late, all the local capital is at his command, and parties from neighboring towns are ready to aid Mr. Bliss in every way. "What fools these mortals be," is an appropriate quotation.

Dr. Norvin Green on Telegraphy. DR. NORVIN GREEN, President of the Western Union Telegraph Company, in an interesting article in the youths' department in the Sunday papers on "Telegraphy as a Profession," refers to the fact that while he had always been an executive officer, either in the old Southwestern or the American companies, which were finally absorbed by the Western Union, the general manager, the second vice-president and other prominent officers had risen from the ranks of the messenger boy. Yet, owing to the small percentage of officials in proportion to the great number of employés, Dr. Green does not consider that his profession offers the same opportunities for advancement to be found in other corporations where the per cent. of officials is greater. Referring to the cost of sending a message, Dr. Green notes a fact seldom remembered, that for each 500 miles a telegram is transmitted the expense of maintaining an extra battery and the services of an extra operator are required. This makes the average actual cost for transmission of messages amount to one-half a cent per word per operator employed. Ultimately, "machine telegraphy" will be largely used, Doctor Green thinks. Another article from the Doctor's pen, in the *North American Review* this month, touches on the same point, and maintains that telegraph rates are not too high. It is, in fact, unreasonable and unjust, he contends, to compare rates in this country with those in the more compact and thickly settled countries of Europe, while, when the comparison is fairly made, the advantage is on the side of America, with the absence of "red tape" and an expensive bureaucracy.

Safety in Overhead Wires. THE state of the underground question in New York City, together with the occurrences of the last few weeks, has naturally centered all eyes upon this city with the expectation that the solution of the problem of the safe running of wires must be looked for in this direction. The result has been that the hundreds of other cities in which overhead wires are operated have been entirely forgotten and the few mishaps recorded here are put down as due to a radical defect in the methods heretofore used. In strong contrast to this view of the case, we find that other cities with overhead wires have been very free from accidents, unquestionably due to the fact that there was no Subway Board to interfere with the electric lighting companies, and that, on the contrary, the authorities have assisted the companies rather than impeded them in their work. As an illustration of this, we refer our readers to a very interesting little article by Mr. M. D. Law, superintendent of the large arc lighting system of Philadelphia. He shows that even with the much condemned underwriters' wire only two accidents have occurred in seven years, and these were due to the carelessness of the workmen and entirely independent of the insulating qualities of the wire. This immunity from accident Mr. Law very rightly attributes to the inspection to which the wires are subjected at all times and to constantly testing the circuits both during the day and while they are in operation at night. He has thus been able to maintain a record for overhead wires which we are certain could not have been excelled, either in economy of operation or immunity from accident with any system of underground wires thus far proposed.

America at Paris. THE criticism has been made that the Paris representation of the United States was not only meagre but of such a nature as to give an entirely erroneous impression of the industries and resources of the country. However true this criticism may be, taking the exhibit as a whole, there were, nevertheless, a few departments in which every American has taken pride, and chief among these is that of electricity. We believe that so far as originality and variety of electrical work exhibited goes, the United States easily takes the lead in spite of the necessarily limited number of exhibitors. We do not say this in any spirit of bravado or vainglory, but after a thorough consideration and examination of all the exhibits. We are confirmed in this opinion by the fact that the percentage of prizes awarded to exhibitors was greater in the case of the United States than in that of any other country. These results are the more gratifying as in not a few instances the incentives for exhibiting abroad were absolutely without any commercial basis. We need only to refer to two such instances, viz., the telephone exhibits of the American Bell Telephone and the Western Electric Companies, illustrated fully in a recent issue. Any one having the slightest knowledge of the condition of electrical affairs in Europe must at once recognize the liberal spirit shown by these companies in the fine exhibits they have made at Paris. Instances of this kind might be multiplied, but enough has been said, we hope, to indicate the spirit which has animated American exhibitors in their good will to the great French nation, and which, we know, will be manifested by the French toward our Columbus exhibition in 1892.

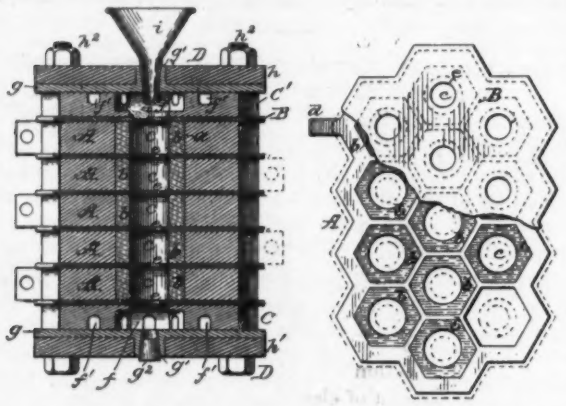
Eickemeyer's Magnetic Gauge.

In the early days of dynamo construction much valuable time was lost and expense incurred from the fact that the theory of dynamo construction involving the magnetic circuit was but little understood; but the work which has been accomplished in this direction in the last few years now makes it possible for machines to be laid down on paper, and having any desired characteristics, with as much accuracy as can be attained in the designing of any of the other well-known forms of prime movers. Such predetermination of the elements of the dynamo involves principally the consideration of the magnetic circuit; and, the quality of the iron being determined, accurate results can be obtained. But, unfortunately, the character of the iron which enters into the construction of dynamos and motors, is not always alike, and hence it becomes necessary, in order to obtain the desired result, to have some means of ascertaining the quality of the magnetic metal upon which the calculations are based.

As this subject is a most important one, we present to our readers the latest form of Mr. Rudolph Eickemeyer's apparatus for this purpose.

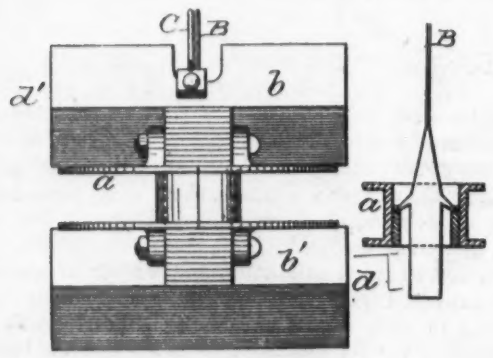
Of the various forms of magnetic gauges devised by Mr. Eickemeyer, all essentially involve at least one pair of magnetic or contact faces of opposite polarity included in a magnetic field, and are bridged or coupled so as to vary that field and to influence an indicator when the magnetic balance is disturbed. The accompanying illustrations, Figs. 1 and 2, show a vertical section and plan view respectively of the magnetic indicator, in which electro-magnets are employed; Fig. 3 is a side view of the same with the field removed, and Fig. 4 shows the needle in side view and its bearings in section.

As will be seen, a horizontal exciting helix *A* is mounted



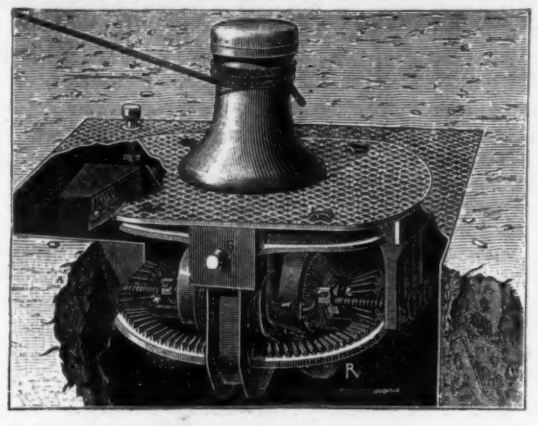
FIGS. 1 AND 2.—EICKEMEYER'S STORAGE BATTERY.

on a spool-like frame *a* of iron to which four counterpart iron bars b b^1 b^2 b^3 are attached, two of these being above and two below the coil, so that when the coil is excited the two upper bars will be of one polarity, for instance, *N* and the two lower bars *S*. Each of these bars at its end affords magnetic contact faces, and, although there are eight of these faces, either of the upper faces can be relied upon for more or less accurate results in connection with the face below it on the same side; but better results are obtained if the upper face *c* co-operates with the diagonally-opposite face *d* on the same side, and in connection with those faces for obtaining certain



results the opposite ends of the other two bars having the diagonally-opposite contact faces *d'* and *c'* are used. The indicator *B* is a magnetic needle mounted upon knife-edge bearings in the centre of the frame *a*, and is normally maintained in a vertical position by the magnets when in their normal condition, and is deflected to one side or the other by variations in the central magnetic field. A graduated plate, *C*, is mounted on top of the upper bars, and the point of the indicator needle can swing toward and from the ends of the plate, the upper bars being cut away centrally to afford a path for the needle.

The operation of the gauge will be understood from an inspection of Figs. 5 and 6, which show two permanent magnets in place of the electro-magnets as shown in Fig. 1. A test-piece *D* of magnetic metal is applied to the rear contact faces of the diagonally-opposite poles *N S*, and as a result the arrangement of the central magnetic field is changed from the normal condition or arrangement indicated in Fig. 5, and as a consequence the indicator needle will be swung into a diagonal position, or respectively toward those poles *N* and *S* which are not coupled by the test piece, as illustrated by the straight dotted line in Fig. 6. The extent of movement by the indicator needle will be shown by the graduated plate, and this in one way reveals the magnetic conductivity of a test piece *D*. If, now,



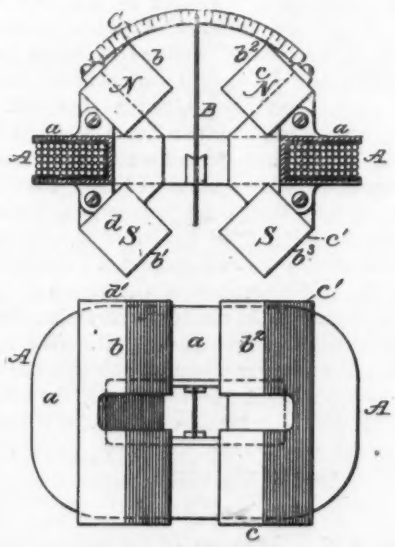
ELECTRIC WINDLASS AT THE PARIS EXPOSITION.

another piece of metal is to be carefully compared with the piece already in position, it must be of corresponding dimensions, and applied to the opposite or front contact faces and diagonally to the position of the first piece; and if the two pieces of metal be of the same magnetic conductivity, one will balance the other, and the needle will therefore resume its normal position. If, however, one piece differs from the other, the degree of difference will be indicated by the position of the needle, and then, for ascertaining what increase of dimension in cross section the deficient piece should have to make it equal to the better piece there are added smaller thin pieces of the same metal until the indicator stands at zero.

The instrument is useful not only in ascertaining the direct magnetic qualities of various metals and alloys, but is evidently also useful in examining the diamagnetic properties of metals, and by means of a suitable series of comparison test pieces the magnetic value of each can be easily obtained.

The Eickemeyer Storage Battery.

Mr. Rudolph Eickemeyer, of Yonkers, N. Y., whose storage dynamo is well known to our readers, has for some time past devoted his attention to storage battery work, and the result of his studies in overcoming the difficulties attached to this form of apparatus has resulted in a novel form of cell, in which the chief aim has been to secure freedom from liability to short-circuiting of the plates due to the loosening of the active material, and on the other hand, the avoidance of the exposure of the metallic lead in the plates to the direct action of the electrolyte, so that the plates themselves remain unaffected and do not form a shunt for the charging current around the active material.



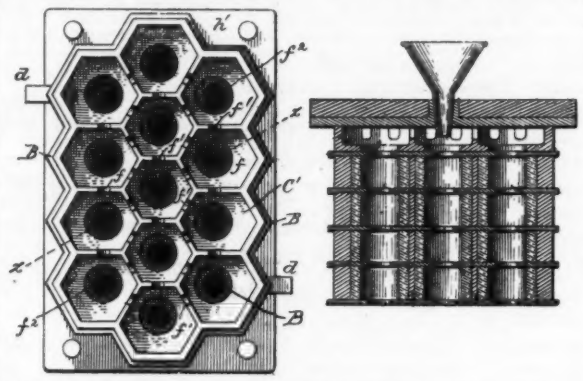
The accompanying cuts, Figs. 1, 2, 3 and 4, show the new form of battery in plan and in section. As will be seen, the cell consists of a flat cast lead plate foundation *A*, provided with a number of holes *a*, polygonal in form. These openings *a* are lined with the active material *b*, which is well packed around plugs, which, when removed, leave the central openings *c*. Each plate has a projecting terminal *d*, and all are counterparts cast from the same pattern, so that when reversed in position and piled one on another with the terminals located alternately on opposite sides, the holes *c* register with corresponding holes in all the plates throughout the pile. Between each two plates there is placed an insulating plate *B*, which is also provided with holes *e*, corresponding to those in the lead plates. These insulating plates project into the central space so that the active material liable to be displaced from the lining of the holes *e* cannot overlap and short-circuit with an adjacent plate, which is prevented by having the holes *e* considerably smaller than the holes *c*, as shown. The whole is provided with a suitable bottom and top plate and clamped together by bolts.

With the battery thus constructed each vertical line of holes *c* constitutes a cell or chamber for containing the electrolyte, and this is supplied by means of a stand-pipe or funnel *i*, which tightly fits the feed-aperture *g'* at the top, the lower central sleeved hole *g'* being meantime stopped by a rubber plug g^2. As the liquid falls to the bottom of the battery it is distributed by way of the lower channels and openings *f'* f^2 in the base-plate *C* to the several cells, in which it rises with uniformity until all are properly filled, even to partially filling the recesses in the upper plate *C'*. It will be seen that an extensive area of the porous material is exposed to the electrolyte, and that the metallic lead of each grid or plate is completely protected against the liquid, except through the active material, and that the gases developed can be freely discharged from all of the cells by way of the upper chambers *f* and channels *f'*. These upper chambers and channels and the holes f^2, with which they communicate, are only partially filled with the electrolyte, because the lower end of the stand-pipe funnel *i* is at such a level that when the electrolyte is supplied up to that point air will be confined in the channels and holes, and resists the further admission of the electrolyte.

Mr. Eickemeyer has designed various forms of these cells, all embodying the same principles, and resulting in a cell of considerably reduced weight in proportion to its storage capacity.

The Electric Windlass at the Paris Exhibition.

As far back as 1880 the Northern Railway Company of France, in their most important freight depot and storage warehouse at La Chapelle, demonstrated that it was more economical to operate the windlasses for raising goods from

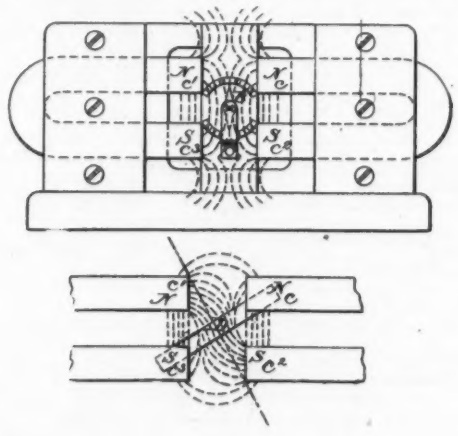


FIGS. 3 AND 4.—EICKEMEYER'S STORAGE BATTERY.

story to story by means of hydraulic engines than by horses, and later on they substituted hydraulic engines also for hauling the cars and turning them on the turn-tables. The maintenance of hydraulic engines requires considerable attention, and hence when the electric transmission of power became an established fact, steps were soon taken to apply electricity for this purpose.

The problem to be solved was by no means a simple one. Experience has proved that the mean duration of the rotation of the windlasses or capstans is in general very short, and that the total effective work produced and expended by each windlass is generally very small. As, in addition, the work is very intermittent in its nature, and the capstans rarely operate simultaneously, the necessary power could not be furnished economically by electrical machines which were continuous in their operation. During a period of eleven hours' work, the windlass most used in the large depot at La Chapelle hardly works more than one hour and forty minutes, or two hours at the maximum, so that it was only in use for 16 per cent. of the whole time.

After debating the application of various forms of mechanism to apply to this purpose, the company at last adopted a system of direct action, and the accompanying illustration shows the manner in which the scheme was carried out. This apparatus, which is shown in the Machinery Hall at the Paris Exposition, was constructed by M. Hillariet. It consists of a cast-iron bell mounted on the vertical axis of a large toothed wheel *R*, in which engage two pinions attached to the shaft of the electric



FIGS. 3, 4, 1, 2, 5 AND 6.—EICKEMEYER'S MAGNETIC GAUGE.

motor, which has two Gramme ring armatures. The whole, capstan, motors, etc., is pivoted on trunnions *G* so as to facilitate examination and repair. Chains and special hooks prevent tipping of the apparatus. The motor is operated by means of a pedal to which is attached a vertical rod, which makes contact over a special switch having three contacts, which puts the armatures in series, or in parallel, and regulates the current.

The windlass is capable of exercising an effort of 400 to 500 kilogrammes, with a linear speed of 0.6 metre per second at the periphery of the body of the windlass. The diameter of the windlass post being 0.4 metre, this linear velocity

FIG. 1.—LANDING OF THE DIRECT UNITED STATES CABLE AT RYE BEACH.

corresponds to about 70 revolutions per minute. At the same time the speed can be reduced to 12 revolutions per minute, as employed for the operation of locomotive turntables. This reduction of speed is obtained by a special coupling of the circuits, and by reducing the voltage from 200 to 100 volts. In order to operate most economically it was decided to put in an accumulator plant in connection with the windlass, as the work is very intermittent, and experience has shown that the batteries only require charging every other day. The plant has been in operation for more than a year, and with marked success.

The Cable Station and Landing at Rye Beach.

We illustrate on this page the cable station at Rye Beach and the cable landing there made. The cable is that of the Direct United States Company, and was laid in 1874. Last spring the tides had worn and worked all the sand and gravel away, leaving the cable bare, and revealing the submerged forest, Fig. 1. Usually cables are buried in trenches three or four feet deep, but in this case the cable lies fully in view as it runs up to the cable station, Fig. 2. The cable shown is the ordinary single conductor shore end. The iron sheathing is entirely intact, and bears no sign of decay. Here and there a few barnacles may be seen clinging to the outside iron armor wires. The cable is only visible during the low spring tide, at all other times being covered with sand. The cable goes from Rye Beach to Halifax, N. S., and is there connected to the cable from Halifax to Ballinskelligs Bay, on the coast of Ireland, a distance of 2,400 miles.

The stumps among which the cable lies are very large, measuring 8 or 10 feet in circumference. They are mostly of cedar and are of a rare quality not known, it is said, to exist in forests of the present age. The forest extends out a considerable distance.

The Overhead Wire Question in New York.

Judge Andrews, in Supreme Court Chambers, this city, last week, rendered his decision in the electric light cases, continuing the temporary injunction restraining the city from interfering with the wires of the United States Illuminating Co. pending the trial of the action for a permanent injunction. This decision, of course, protects the other electric light companies as well as the plaintiff company.

Judge Andrews decides that the electric light company has the right to maintain its wires overhead until the subways for their accommodation are completed, and fixes the responsibility for the failure to complete the subways on the Subway Company, but says that the duty of keeping its wires properly insulated devolves on the plaintiff, and that permission to repair old wires and replace them with new and safe wires should be obtained from the Board of Electrical Control by mandamus if refused. The decision ends as follows:

"My conclusion upon the whole matter is this: The Legislature authorized the plaintiff and similar companies to erect poles in the streets and string wires thereon to be used for furnishing light and power; it subsequently adopted laws with the view to having such wires placed under ground in conduits and subways. For some reason but few of these conduits and subways are ready, and the plaintiff and other similar companies cannot put their wires under ground. Pending the construction of such subways they have the right to maintain their overhead wires. Some of these wires are undoubtedly dangerous to life and ought to be repaired or removed. The Board of Electrical Control has the right to require the plaintiff and similar companies to discontinue the use of such dangerous wires, but has not the power to compel the plaintiff and other companies to remove the same; the Commissioner of Public Works cannot remove the same without notice to the plaintiff and without giving it an opportunity to put its wires in safe condition, but can do so after giving such notice and a reasonable opportunity to make repairs; the company should have such reasonable opportunities to put its wires in safe condition, and if it does not do so, the same should be removed by the Commissioner of Public Works as obstructions, or the matter should be laid before the Grand Jury of the county; in the meantime the injunction heretofore granted, with some modification of its general restrictions, should be continued until the trial of the action.

"If the view taken by me in this matter is erroneous in any respect, a speedy review of my decision can be obtained by bringing the case on for trial at the Special Term to be held in November, or by an appeal to the General Term from the order continuing the injunction, and I make it a condition of the granting of such order that the plaintiff stipulates to take short notice of trial for the November term, and to try the case at the first opportunity, and also stipulate to argue the appeal from such order, if one shall be taken to the General Term, at the term which shall commence on the second Monday of November. The order will be settled on notice."

At the same time, the jury in the Feeks inquest declared their inability to fix the responsibility for the shock by which the man was killed, and made the following important recommendations:

"We find that the system of overhead wires, as at present operated in this city, is a constant menace to the lives and property of the citizens, and that electric wires, whether transmitting low or high tension, should be thoroughly insulated.

"That the linemen of the telegraph and telephone companies, as well as all electric light companies, should be imperatively required to wear rubber gloves and to use insulated instruments while working upon the lines.

"We condemn the use of the wire known as the underwriter wire, and recommend its immediate replacement with properly insulated wires.

"In view of this accident and of the danger from the overhead electric light wires, which this investigation has shown to exist in this city, we make the following recommendations:

"That the subways should be extended with all possible dispatch until all wires in the city, both trunk lines and branches, are placed under ground.

"That while such subways are being provided wires transmitting high-tension currents should not be suspended upon the same poles with telegraph and telephone wires.

"That a licensing board be appointed by some proper authority and maintained by the various companies furnishing electricity which shall grant permits only to men who have passed an examination proving themselves competent to intelligently perform the hazardous duties of linemen.

"That we are convinced that the present antagonism between the Board of Electrical Control and the corporations supplying electricity is such as to prevent the safe conduct of electric business in the city, and we recommend on the one hand that these corporations exercise more readiness to obey the reasonable regulations of the board, and that, on the other hand, the board inforce its rules with greater regard for the vast amount of capital invested, and with a particular view of providing for the public the very best service."

The companies have been busily engaged renewing their circuits with high insulation wire, and have now a great many more of their lights running.

The Edinburgh International Exhibition of Electrical Engineering, General Inventions and Industries, of 1890.

Our special correspondent writing from Edinburgh recently, made mention of the fact that active preparations were going on for the holding of an international exhibition of electrical engineering in that city. We have just received the full prospectus of the exhibition of which electrical engineering is to be the principal feature. Previous electrical exhibitions in Great Britain have been little more than exhibits of electric lighting, but in this exhibition it is intended to show the applications of electricity to as many branches of industry as possible; to demonstrate its usefulness in workshops of various kinds, and more especially to show what electricity can do in the way of electric traction. In this department, our readers are aware, Great Britain is very greatly behind the United States, not for lack of opportunities, since large tracts of land, especially in Scotland, are as yet unserved by the ordinary railroads, while horse railways exist in every town of importance in the kingdom. It is to be hoped that the effects of the Edinburgh Exhibition will become evident in greatly extended development of electric traction in Scotland, where abundance of water power exists. The transport of power by electricity for the purpose of driving motors, and the subject of electric lighting stations, are now prominently before the British public, and both these branches of electrical energy may be expected to receive an impetus from this exhibition.

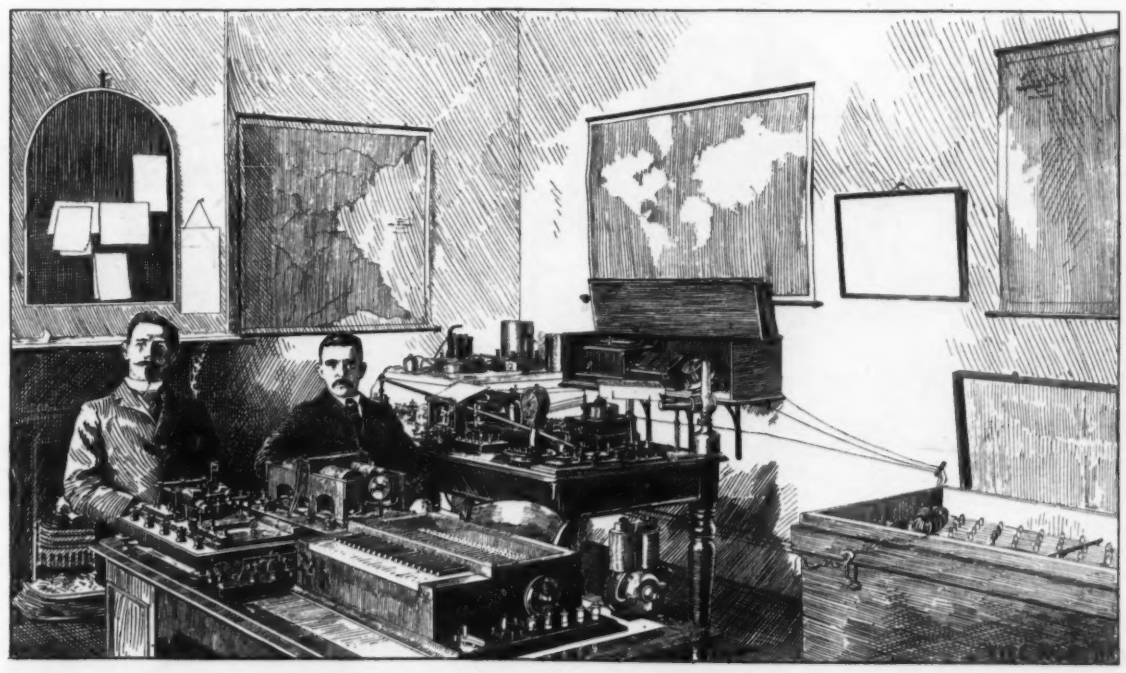


FIG. 2.—DIRECT UNITED STATES CABLE STATION, RYE BEACH.

A plan accompanying the prospectus shows a canal running past the exhibition on the south side, and this canal will be available for the purpose of showing the various applications of electricity to navigation. It is proposed to establish a regular service of electric launches and boats between the exhibition and the centre of Edinburgh, where the canal terminates. Another branch which is to be carried out is to exhibit the possibility of converting wind power into electric energy by means of windmills and accumulators.

A lecture hall, in which important lectures are expected to be given, will be established in the building, and it is hoped that meetings of various learned societies will be held therein.

The exhibition is under the patronage of the Queen, and the Lords Provost of Edinburgh and Glasgow, together with the Lord Mayor of London, Sir William Thomson, Thomas A. Edison, W. H. Preece and Sir John Fowler, designer and engineer of the Forth bridge, are among the Vice-Presidents, while the ex-Lord Provost of Edinburgh is Chairman. The Forth Bridge will be opened for traffic about the same time the exhibition begins, and as special trains will be run from the station to be established by the North British Railway Company within the exhibition grounds to the Forth Bridge for the purpose of enabling the visitors to view the bridge, the Forth Bridge will practically be part of the exhibition.

Owing to its position on two main lines of railway, it will be possible to deliver exhibits at a minimum cost, for no cartage whatever will be incurred as the railway tracks run right into the exhibition.

In connection with the exhibits that it is hoped will be got from America, it has been thought that if proper representations are made to the American Government, who are under an obligation to bring back to the United States the American exhibits at Paris, they would agree to extend their obligation to the extent of bringing the Parisian exhibits to Edinburgh and thereafter taking them back free of cost to the United States. Also that the United States Government, in view of the impetus such an exhibition is calculated to give to American trade, might be induced to transport other exhibits free from America to Edinburgh and back again.

Applications for space must be made on forms which will be supplied by the General Manager, Exhibition Offices, Edinburgh, and ought to be filed before Dec. 1. The prospectus of the exhibition, together with the plan of buildings and regulations, can be seen at The Electrical World offices.

Temperature of Incandescent Filaments.

To the Editors of The Electrical World:

Will you please inform me at what temperatnre (Fahr.) the filament of a 50-volt Sawyer-Man lamp in maintained?

Pueblo, Colo. D.

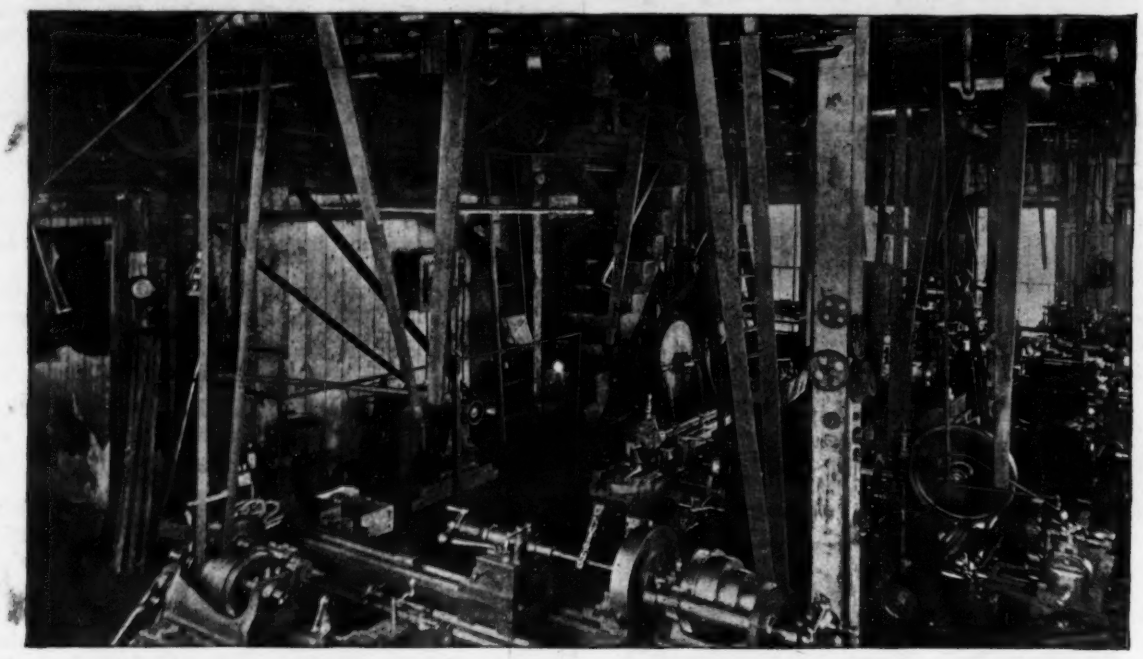
Answer.—We know of no tests that have been made on this particular lamp to determine this point. According to Professor Dewar the temperature of the filament of a Swan lamp at normal brilliancy is 1,900 C. degrees, or about 3,450 degrees Fahr.—Eds. E. W.

The Thomson-Houston Motor in Machine Shops.

It is not at all strange that the electric motor, instead of the steam engine, should be used in such a place as is shown in the accompanying illustration.

The motor generates no heat or dirt, and, compared with a steam engine, requires a minimum of care and attention and occupies a very small space.

The motor (10 h. p.) was manufactured by the Thomson-Houston Electric Company. It has been found to be of especial advantage in that it is always ready for action, thus rendering it possible to start the machinery at short notice and run overtime when necessity demands it. The machine shop shown is that of Mr. T. F. Beale.



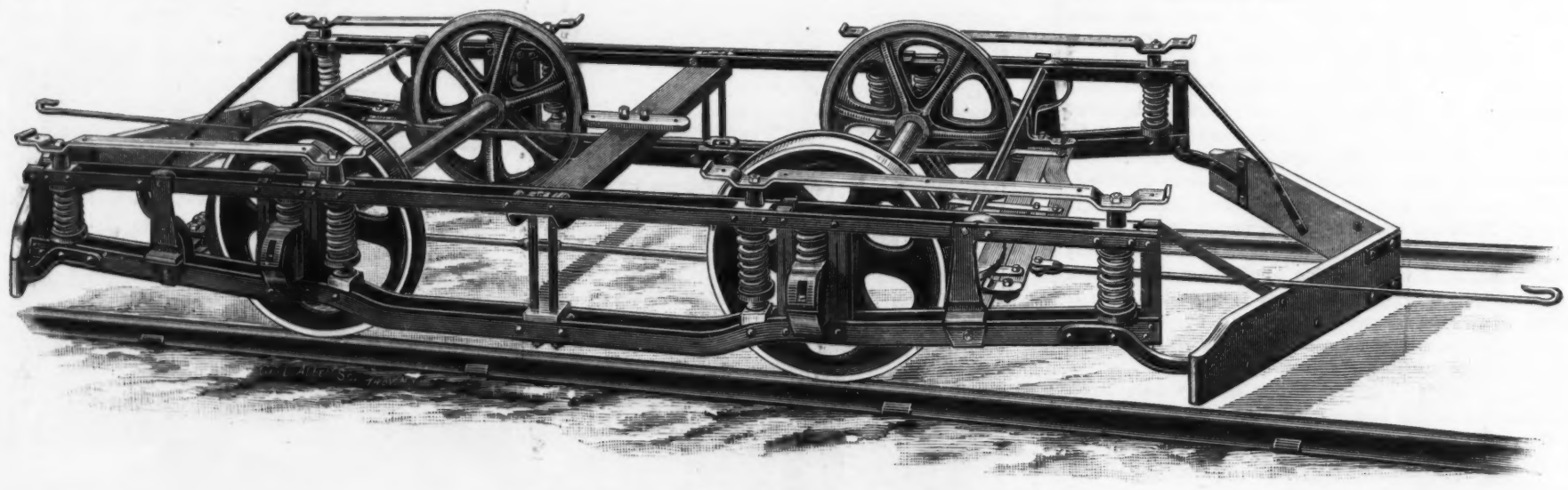
THOMSON-HOUSTON MOTOR IN A MACHINE SHOP.

Manier's Electric Car Truck.

We illustrate in the accompanying engraving a new street-car truck, designed by Mr. B. F. Manier, Superintendent of the Gilbert Car Works, Troy, N. Y., for electric railway work. Its main feature is the arrangement of the springs, which are located so as to prevent the tilting and longitudinal oscillatory motion so annoying in street cars. By constructing the frame of double wrought-iron longitudinal bars, depressing the lower ones a few inches and dispensing with the usual side braces, ample openings are left on either side for removing the armature, adjusting the brushes, and for inspecting the motor from the outside. With the present trucks these operations are usually performed through a trap-door in the floor of the car. To remove the car body from the truck it is only necessary to take off eight nuts and then raise the body 1½ inches.

As shown in the cut, the truck has a double spring action. The springs placed directly over the axle take all sudden shocks without communicating them to the car body, while the body itself is supported by eight independent springs. The truck is furnished with a novel double-acting brake, the brake beams sliding in horizontal slots and supported by the upper and lower beams of the frame. The two connecting rods are provided with turnbuckles, enabling a fine adjustment of the compound levers so that the brakes may be simultaneously applied to the outside of the four wheels in a half turn of the brake wheel, and a leverage of 1 to 80 obtained.

Four of these trucks are now in use on the Lansingburg & Troy Electric Railroad, and sixty more are ordered by various street railroad companies. Those already in use are giving unusual satisfaction.



THE MANIER CAR TRUCK FOR ELECTRIC RAILWAYS.

What Constitutes Safety in Overhead Wires.

BY M. D. LAW.

The article in the last number of The Electrical World entitled "The Question of Safe Overhead Wires" was read by me with much interest, and while I heartily commend the use of the best insulated wires for overhead construction, I do not think it best to rely entirely on insulation for safety. For I have not seen any insulation sufficiently durable to withstand for any length of time the chafing of tree limbs or of rusty iron wire from broken telephone and telegraph lines rubbing the insulated wire, more especially during a heavy rain storm.

With lines constructed of first class insulated wire, (of which there are a number on the market), and given the same care as required by underground wires, by never allowing a circuit to burn on which there is a ground, the late deplorable accidents could only have occurred by the carelessness of the workmen in making joints or cutting circuits.

I have been engaged in out-door arc-lighting for the past nine years. For seven years I have used underwriter's wire, and during that time but two of my workmen have met with fatal accidents, and those would probably have happened with the best insulated wire, as in one case the accident occurred while making a joint, and in the other the lineman opened a live circuit in moving his cut-out.

I attribute the freedom from fatal accidents in Philadelphia to the close inspection given all wires both by the city officials and by ourselves. Our tests are made on clear wires three times a day, on live wires every two hours. These tests are severe, and by the method described by me in a paper read at the convention at Niagara Falls,* which method has since been perfected. I am by that method able to detect a leak of ten volts, and locate a ground to within a distance of 200 feet. A most valuable feature of my method is the detection of swinging grounds. It is only the testing of lines often and the clearing of all grounds at once that reduce the danger of electric light wires to a minimum, thus preventing the deadly second ground.

Alterations in French Telephone Rates.

As a result of the taking over of the Paris telephone system by the French government, the charges made for the use of the public telephones are to be modified. The price for five minutes' use of the telephone for Paris is to remain unchanged at 50 centimes. For the use of the long-distance wires the charge will be variable, according to the distance, and will be calculated at the rate of 50 centimes per 100 kilometres for every five minutes' conversation. Thus the charge of three francs now made for five minutes' conversation between Paris and Marseilles will be raised to at least four francs, as the distance separating the two places is over 800 kilometres. On the other hand, the price for the use of the telephone existing between Rouen and Paris will be reduced to 1 franc 50 centimes.

Electricity and Trichinæ.

To the Editors of The Electrical World:

Would you kindly state your views on the following subject. Will a charge of sufficient strength, alternating or direct current, annihilate the trichinæ in the hog, that is, will it kill the trichinæ cell? McK.

Lima, O.

Answer.—Lacking the evidence of direct experiment we incline to the opinion that the method proposed would be hardly practicable, as a current of sufficient strength to destroy the vitality of the trichinæ cell would also destroy the flesh so as to make it unfit for food. There might be in such a method an improvement on the Chinese practice of obtaining roast pig.—Eds. E. W.

* See E. W., Aug. 17, 1889.

Some Methods of Regulating Accumulators in Electric Lighting.*

BY GEO. B. PRESCOTT, JR.

In preparing the following paper, the limited scope of which is indicated by its title, I have assumed that it is generally conceded that the modern electric accumulator is an apparatus capable of performing a peculiar but useful function in the art of electric lighting as now commercially practiced, and that it is free from defects which would render it unsuitable for such application. Indeed, I am sure that every careful observer has noted in the somewhat slow evolution of the accumulator, that structural improvement and adaptation to practical requirements which unquestionably show that it has come to stay, and will acknowledge that even as it exists to-day, the accumulator is a factor in electrical industry too important to be ignored by those who take a broad view of the situation.

It is not my intention to refer to those numerous successful applications of accumulators to the propulsion of small marine vessels and land vehicles, to car lighting and other minor work where the continuous generation of power from the combustion of fuel would be impracticable; neither can I fully discuss their characteristic actions under working conditions, within the limits of this paper. Nevertheless, before proceeding to the subject proper, I deem it incumbent to point out that the electrical accumulator, even in its more improved forms, is an apparatus having well-defined limits of capacity and that these limits cannot be habitually exceeded without endangering its effectiveness and impairing its durability. Generally speaking the limits referred to, which vary with every type and size of cell, relate to the rate and quantity of charge and discharge, these factors being measured respectively in ampères and ampère-hours.

In considering this admission, however, it should not be forgotten that every dynamo-electric machine is, to a certain extent, subject to similar limitations; for, like the accumulator, if it is demanded of them, they are capable of generating a current far exceeding their safe carrying capacity. Here the likeness ceases, however, for while the dynamo will deliver its normal current as long as adequate power is applied to its shaft, by continuing to draw current from an accumulator for too long a time, as likewise from an excessive rate and quantity of charge, serious damage may result. In fact, in some respects an accumulator may be likened to a draught animal, which can be made to perform abnormally large amounts of work for short periods of time, but only at the expense of its vitality if the practice is frequent.

While much might be said regarding the maintenance of accumulators, and, moreover, the apparatus to be presently described is employed in a large measure for the purpose of effecting proper maintenance as well as regulation, it must suffice to say here that the normal working rate and capacity of an accumulator battery having been stated by the makers, all necessary data relating to its use may be ascertained from the indications of ordinary hydrometers, ammeters and voltmeters. That is to say, during the charge and discharge of such a battery the rise and fall of its potential and of the specific gravity of the electrolyte in its cells, are both quantitatively indicative of its condition and capacity for doing work. It is evident from what has already been said regarding the importance of working accumulators within certain prescribed limits, that in order to effect this result two classes of apparatus must be provided with every accumulator installation, viz.: Indicating or measuring instruments, and regulating appliances to be operated either automatically or by hand. I am constrained to add here that careful and extended observation leads me to believe that a lack of appreciation of these now obvious facts will largely account for the ill success attending many of the earlier accumulator installations.

Although there is reason for believing that some of the early promoters of business enterprises based on the manufacture of electrical accumulators, anticipated that accumulator systems of lighting were destined to compete with and perhaps supersede many direct systems, I believe that the more mature modern idea is that they are, for the present at least, mainly subsidiary to other electric lighting systems. As auxiliaries to many direct systems, accumulators undoubtedly effect a reduction in running expenses, and add an element of reliability, besides accomplishing certain results that are not otherwise obtainable. In order to fully appreciate the truth of these statements, it will be necessary to glance at the conditions commonly existing in ordinary isolated and central station plants as they are operated at the present time. Doubtless every one who is familiar with the electric lighting business is acquainted with the vagaries of the load curves during each 24 hours of a central station's run. Generally speaking, about sunset the load begins to increase gradually, finally reaches a maximum which is maintained for a greater or less period of time, and then falls to a minimum, about which it fluctuates for the remainder of the twenty-four hours. Almost every isolated plant, whether it be in office building, hotel or apartment house, has a curve of the same general character; and probably most manufacturing establishments would prefer to have a few lights burning through the night, if only for the watchman's convenience, were it not for the expense entailed by the continuous operation of the plant. It is a truism to say that the cost of fuel per horse-power increases inversely as the power plant operates below its normal capacity, and that other operating expenses are, to a considerable extent, fixed independently of the load. In view of these facts it is universally acknowledged that the operation of large power plants of any character during periods of light loads, is enormously wasteful. Many have hoped that the supplying of current to small electric motors during the day would remedy the evil in lighting stations, and to some extent the expectation has been realized in manufacturing centres; but even here the unfortunate overlapping of the motor and lamp service still leaves an undesirable margin.

Here, then, is a field in which accumulators may perform their special function, not in competition with direct systems, but as supplying the missing feature in the commercially successful operation of 24-hour plants of moderate size. There is no obstacle in the way of applying a sufficient number of accumulators to a plant of the character mentioned, to maintain the light load during the time it would not pay to operate the power plant, and to provide for the charging of the accumulators during the regular running time of the dynamos. Assuming, in illustration of this statement that 10 hours is the ordinary working day, and that the engines of a central lighting station are started at 2 P. M. and are operated until midnight, it is probable, if not certain, that there will be sufficient surplus current for an ample length of time to charge enough accumulators for the service required after the engines cease to revolve, excluding, of course, the period of maximum load, when the dynamos will be taxed to their full capacity in their regular service. Under such conditions the engines could be operated at somewhere near their normal capacity during the whole period of their running time, and the cost of unit power would be a minimum, while only one staff of men will be required. It may be advisable to explain here that although the current available for charging the batteries during the regular running time of the dynamos would vary with the lamp load, this is of no importance, as it is not essential that the batteries should be charged at a uniform rate. In the case of such stations as also supply arc lights, the engines could be started later and operated through the night. Besides reducing the operating expenses of a station during its periods of light load to a greater extent than they increase them at other times, in the event of an accident to the power plant or incandescent dynamos, the accumulators can always be called upon for extra service; while whenever there is an abnormally heavy demand for current, they may also be operated in conjunction with the dynamos.

But there is still another field in which accumulators may be employed to equal advantage, viz., that of long-distance lighting now so successfully occupied by the alternator-converter system. An accumulator is indeed merely a chemical converter, which is unequaled as a pressure-reducer, and any one who gives careful thought to the subject will perceive what an excellent substitute it is for the alternator-converter in those situations where the character of the lighting makes it necessary to run "light" for many hours each day. Indeed, I can only account for the fact that accumulators were not long since more extensively used for this class of lighting, by the existence of a feeling of skepticism as to their durability, together with their somewhat formidable first cost.

As manufacturers now guarantee the durability of accumulators, under certain conditions of use, for an annual percentage on their first cost, and as methods of manufacture must improve with experience and moderate that cost, both of these objections are gradually being modified.

But even in the present state of the art, the question of first cost, depreciation and efficiency may be duly allowed for, and a considerable reduction in operating expenses still shown to result from the use of accumulators under many circumstances. To quote from an article by the writer "On the Place of Accumulators in Electric Lighting," which was published in the March issue of *The Electrical Engineer*:

"Whenever one kind of energy is transformed into another kind, more or less loss can be shown to occur, and the action of the accumulator is not an exception to this rule. The proportion of loss generally varies with the conditions under which the transformation is effected, and in the case of the accumulator depends mainly upon the rate of charge and discharge. If these double transformations are conducted slowly the loss may be nearly inappreciable, but at the higher rates which are frequently demanded in practice the efficiency is proportionately reduced. The fact of the existence of this loss clearly indicates that the direct production and consumption of electricity must always be less expensive, both in original outlay and cost of production, than its subsequent use through the medium of accumulators; unless, indeed, there are other modifying conditions which overbalance the additional cost of accumulators and offset their maintenance. That such conditions do exist in many branches of the electric lighting industry can be readily demonstrated, and it may likewise be shown that the use of accumulators as auxiliaries to many existing lighting plants would insure a marked reduction in their running expenses. * * * * * *

"From what has already been said regarding the infallibility of loss resulting from any form of conversion of energy, it is evident that if the load were equal to the capacity of a plant for 24 hours each day no system of conversion could compete in point of economy with one which effected the direct production and use of the current. There is an exception even to this general statement, however, when one or more groups of lamps are located at such a great distance from the source of power, that the interest on the cost of conductors, together with the cost of the energy wasted in them, becomes of serious importance, not to mention the increased difficulties of regulation. In cases of this character, the value of the accumulator as an auxiliary to a direct incandescent system becomes obvious. The cells may be located directly at the centres of consumption and charged by a moderate current at high pressure over a small conductor. They may be charged during the hours of light load and discharged as required, the whole charging current, in addition to the current of the batteries, being available on the lamp circuits during the period of maximum load, if it should be so desired. Often the interest on the cost of such an accumulator installation, plus the cost of the energy lost in conversion of current, is much less than the loss by the direct system as previously specified. Another and vastly important consideration in favor of the accumulators is that during the 10 or 12 hours of each day when the consumption of current is so small that a station can only be operated at a loss, the power could be shut off entirely and the accumulators resorted to for the current required during that period."

As a matter of fact, the ideal condition of a continuous maximum load, as assumed above, nowhere exists in practice. The actual load curves for stations of similar capacity throughout the country differ not only in respect to the duration of the maximum period, but likewise in the hours during which the light and heavy

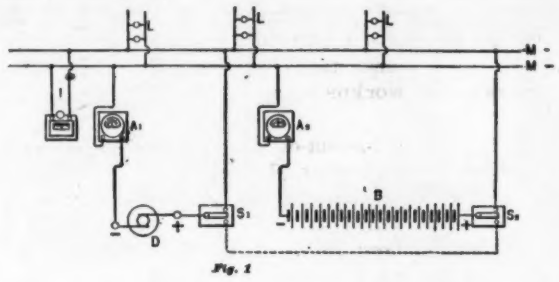


Fig. 1

Fig. 2

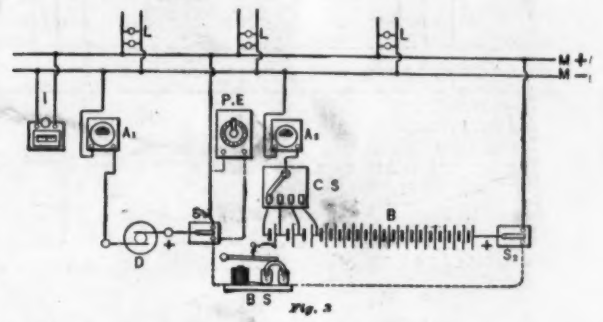
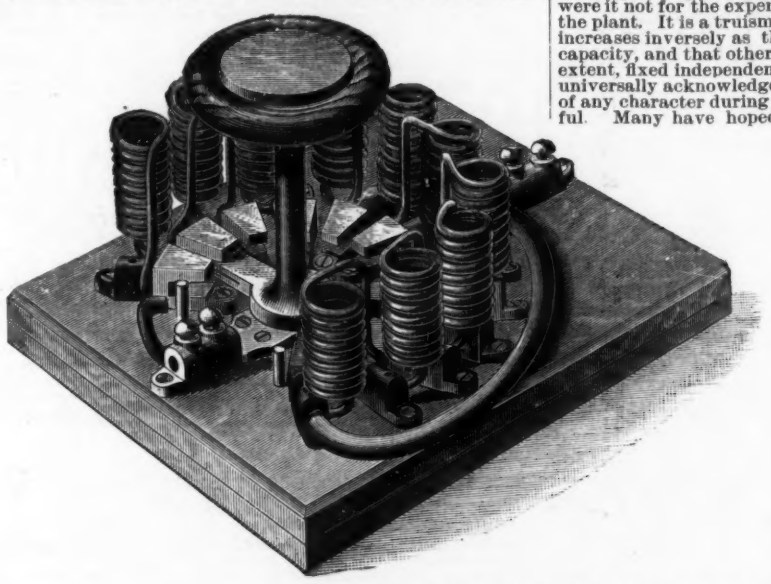


Fig. 3

FIGS. 1, 2, 3 AND 4.—SOME METHODS OF REGULATING ACCUMULATORS IN ELECTRIC LIGHTING.



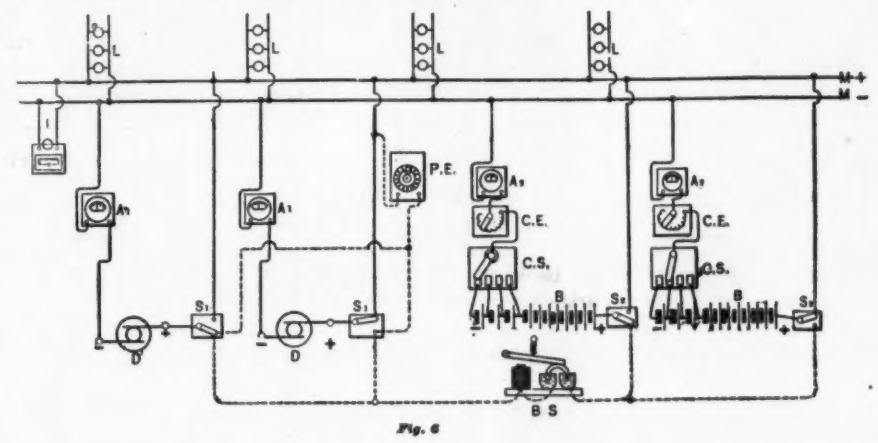


Fig. 6

FIGS. 5 AND 6.—SOME METHODS OF REGULATING ACCUMULATORS IN ELECTRIC LIGHTING.

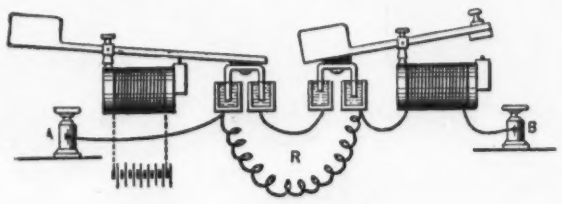


Fig. 7

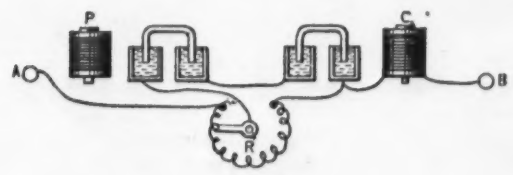


Fig. 9

FIGS. 7, 8 AND 9.—SOME METHODS OF REGULATING ACCUMULATORS IN ELECTRIC LIGHTING.

*Paper read before the American Institute of Electrical Engineers, New York, Oct. 29, 1889.

loads occur, according to the character of the lighting. It is, nevertheless, true that they all show a remarkable similarity in the variation of current consumption, and all the 24 hour stations, particularly the smaller ones, require but a very small portion of the capacity of the plant for the greater part of the day. For this reason, many of the smaller stations cannot be profitably operated for more than 12 hours a day, and customers are therefore unable to obtain the light for the remainder of the 24 hours, the system being thereby deprived of much of its value to many consumers.

Here again the utility of the accumulator for tiding over these costly periods of light loads becomes apparent. It is evident that any ordinary station running for 12 hours a day, more or less, is not likely to have an output approaching its capacity for more than two hours at the longest, while for the greater part of the time it will be much below it. Why should not such a st tion be operated during that period of 12 hours at somewhere near its full capacity, and, therefore, under the most economical conditions for the power produced, and utilize the excess of current to charge a sufficient number of accumulators to maintain the lighter load during the remainder of the day?

This is the legitimate work of accumulators, and when they are properly installed and maintained to meet such conditions, the class of small stations referred to will be enabled to supply satisfactory light for 24 hours a day at moderate cost, while the larger stations may greatly reduce their running expenses, and at the same time maintain the efficiency of their service.

Before proceeding to consider the methods of regulating accumulator currents, it will be advisable to examine some of the peculiarities of the element with which we have to deal. Generally speaking, the total current capacity, expressed in ampère-hours, of a single cell of accumulator of the lead lead-oxide type, is proportional to the number and size of its plates; its rate of discharge depending upon the number of plates and the effective surface of each, while the time of such discharge varies with their thickness. Although there are no obvious theoretical reasons why a single cell of accumulator should not be made sufficiently large to possess any desired capacity, there are mechanical considerations which make it advisable to limit the dimensions of a cell to the extent that it may be conveniently portable. Therefore, when higher rates or longer discharges than an ordinary cell will give are demanded, two or more cells must be connected in parallel. On the other hand, the electromotive force of all sizes of accumulators composed of the same elements is of course identical, but as the internal resistance of a cell varies with the number and surface of its plates, its effective working potential must be a function of the strength of the discharge current. As, however, the internal resistance of all sizes of accumulators is, in virtue of the large surface and compactness of their electrodes, exceedingly small in comparison with their rate of discharge, their working potential nearly equals their electromotive force on open circuit. While the normal effective working potential of a fully charged accumulator in good condition is usually stated as about two volts, as a matter of fact it is somewhat higher than this after being charged, and rather lower after normal discharge, the average effective potential being about 1.95 volts. During the operation of charging an accumulator, its potential, or what is then usually called its counter electromotive force, rises gradually until the cell is nearly charged, and then more suddenly as gas is evolved, sometimes requiring an effective charging pressure of as high as 2.5 volts per cell if the current is continued after the cell is charged. In actual practice the accumulator is usually considered to be fully charged when the potential of the normal charging current reaches 2.3 volts per cell, or at 2.2 to 2.25 volts per cell when the charging rate is reduced as gas begins to be freely evolved towards the end. Similarly when a cell is discharged at the normal rate its effective potential falls during the progress of the discharge from 2 volts to 1.8 volts, at which latter point it is considered to be discharged to its normal limit.

The facts above cited, to the effect that the electromotive force of accumulators rises during charge and falls during discharge, and that their capacity for charge and discharge is limited, are the keynotes to the regulative processes; and only one other point need be here considered. When two or more series of cells connected in parallel are to be charged at the same potential, it is evident that, unless each series is in precisely the same state in respect to residual charge, there will be a difference in their electromotive forces; and, in consequence, less current will flow in those series having higher potentials than the others. While the larger current flowing into the less charged cells will have a tendency to bring up their potentials to the average, it is found in practice that some series will become fully charged sooner than others. The simple means provided for compensating for these variations will be duly described.

One of the commonest, and perhaps the simplest, applications of accumulators to lighting work is found in their employment in connection with direct isolated plants in factories, office buildings, etc. In illustration of the method of applying accumulators in such cases, we may select as a type of this class of lighting one of those office buildings common in New York and other large cities. This building, we may assume, has already been, or is about to be, wired for 500 16-candle, 100-volt, ¼-ampère lamps on the multiple arc plan, and is to be provided with a 125-volt, 200-ampère dynamo; it being calculated that more than 400 lamps will rarely be lighted simultaneously. We are not specially concerned with the power plant, and will simply assume that it is of ample capacity, it being remembered that such buildings are usually steam heated, and, therefore, offer favorable conditions for the operation of a plant of the character under consideration. Now it can be deduced from experience, that during the day from say 9 o'clock in the morning until about sunset, only a limited number of lights will be burned in certain dark corners of the building, and that as twilight and darkness come on the load will gradually increase, reaching a maximum at a certain hour, depending upon the season; subsequently the load will decrease, finally reaching a minimum after the janitor and his assistants have finished their cleaning operations, which load will probably be maintained for the remainder of the twenty-four hours. It is evident that a direct plant operating under such conditions would necessitate the employment of two forces of men, either one or two in each, and would, moreover, be running under exceedingly uneconomical conditions for a large part of the time. Let us now consider in what manner accumulators may be added to this plant in order that it may supply the variable load for twenty-four hours daily, while at the same time dispensing with the services of one staff of men and reducing the running time of the engine to eight hours.

It has been shown in a general way how the load varies during 24 hours; but in order to ascertain the capacity of the accumulators required, it will be necessary to assume, though only approximately, somewhat more precise figures. Say that the load is as follows:

From 9 P. M. to 9 A. M.,	20 lamps	= 120 ampère hours.	
" 9 A. M. to 4 P. M.,	200 "	= 700	"
" 4 P. M. to 6 P. M.,	400 "	= 400	"
" 6 P. M. to 9 P. M.,	50 "	= 75	"

An inspection of the above schedule shows that for 12 hours out of the 24 only 20 lamps, or 10 ampères, are used, while for three hours more only 50 lamps, or 25 ampères, are required; and a simple calculation proves that a set of accumulators having a capacity of 200 ampère hours will be amply sufficient to maintain the light lamp load for 14 hours out of the 24. If the dynamo is started at 8 A. M. and operated until 6 P. M., while maintaining the required number of lamps during that period, it will still have surplus current for charging the battery as follows:

From 8 A. M. to 9 A. M., 190 ampères for 1 hour,
" 9 A. M. to 4 P. M., 100 " 7 hours,

or 890 ampère-hours, an available capacity ..astly in excess of the requirements. Now, if during the eight hours in which the dynamo is operating the accumulators are charged at the rate of 30 ampères, in that period they will receive a total charge of 240 ampère hours. According to the schedule, the maximum output required from the battery will be 185 ampère hours, whence it follows that the charge received by it is more than ample, even after making the customary allowance of 20 per cent. for loss by conversion; and the desired result has been accomplished.

We have now to consider the details pertaining to the practical arrangements of such an installation. According to the stipulated schedule, after the dynamo ceases to run at 6 P. M., the battery alone must supply 25 ampères for three hours, and thereafter 10 ampères for 11 hours, or a total output of 185 ampère-hours. One series of 50 cells, having, say, a normal capacity of 30 ampères for eight hours, will satisfy these requirements, and will be well within the nominal rating of ordinary commercial cells. Assuming that these 50 cells, connected in series, have been suitably placed on insulated shelving at any convenient distance from the dynamo, they may be electrically connected with the latter and with the lamp circuit, as shown diagrammatically in Fig. 1.

In this diagram the two parallel wires M (+) and M (−) represent the common dynamo and lamp mains to which the pressure indicator I is permanently connected in the usual manner; and L L L represent the lamp circuits. The dynamo D is connected to the mains through the ammeter A_1 on one side, and through the upper contact of the two-way switch S_1 on the other. These are the ordinary connections of a multiple arc plant; and the (+) and (−) terminals of the accumulator battery B are also connected with the mains through the ammeter A_2 and two-way switch S_2 in precisely the same way. It is evident that if the levers of both switches S_1 S_2 are against their upper contacts, the dynamo and battery will supply current to the lamp circuits in exactly the same manner as would two dynamos connected in parallel, provided, of course, that they are both at the same potential. On the other hand, if the potential of the dynamo slightly exceeds that of the battery, the current from the former will divide between the battery and the lamp circuit in a certain proportion determined by the ratio of the resistance of the lamp circuit to the internal resistance and counter electromotive force of the battery. If the levers of the two switches S_1 S_2 are now moved to their lower contacts, the dynamo and battery will be connected in series with their like poles opposed, the main M (−) acting as part of the circuit; and supposing that the pressure of the dynamo still exceeds that of the battery, the latter will receive a charge. Thus, by this very simple arrangement, the dynamo and the battery, either separately or together, may be connected with the lamp circuit, or with each other, or be entirely disconnected.

While this method satisfies all but one requirement in certain classes of plants where it is convenient to employ the dynamo solely for charging the battery during a part of the day, and to use either the dynamo or battery, or both, in the lamp circuits at other times, it does not, in fact, satisfactorily permit of that splitting of

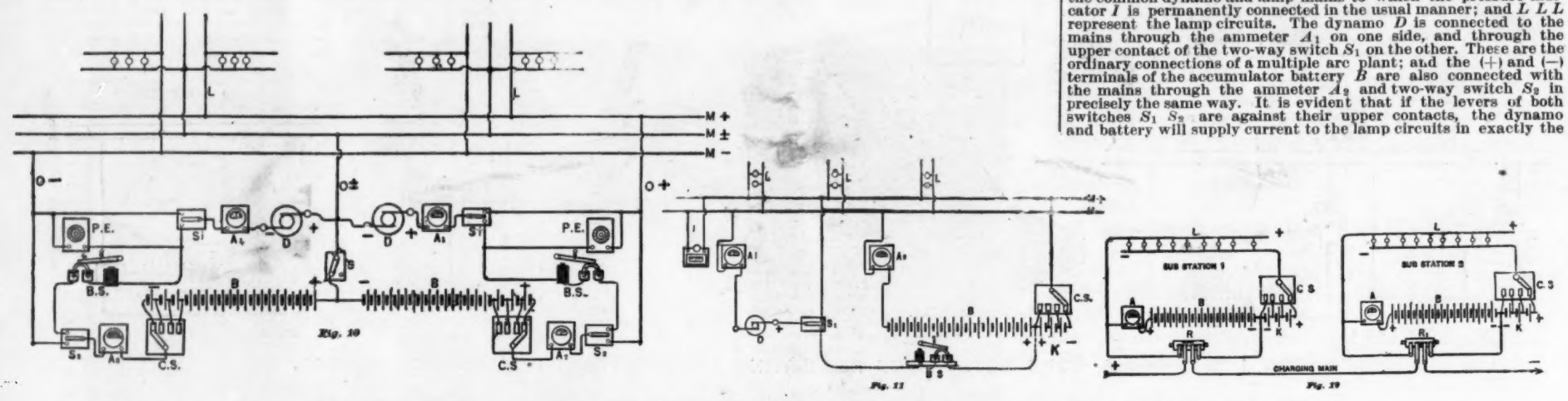


Fig. 10 Fig. 11 Fig. 12

FIGS. 10, 11 AND 12.—SOME METHODS OF REGULATING ACCUMULATORS IN ELECTRIC LIGHTING.

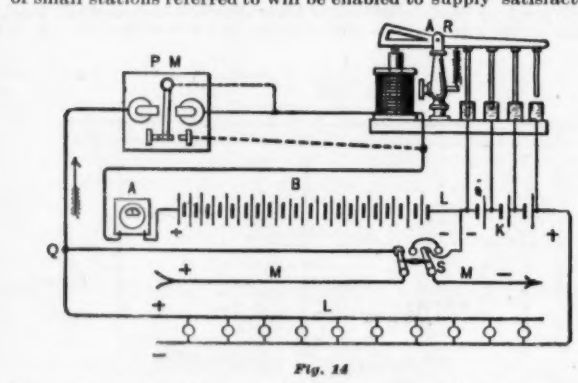


Fig. 14

FIG. 14.—SOME METHODS OF REGULATING ACCUMULATORS IN ELECTRIC LIGHTING.

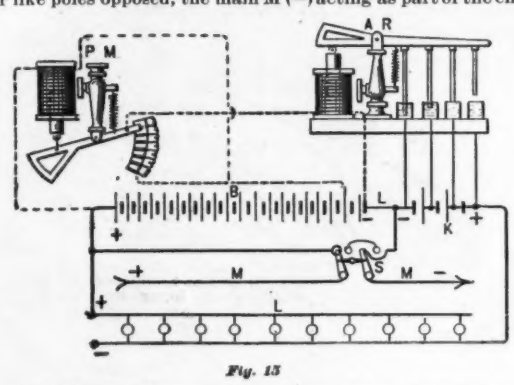
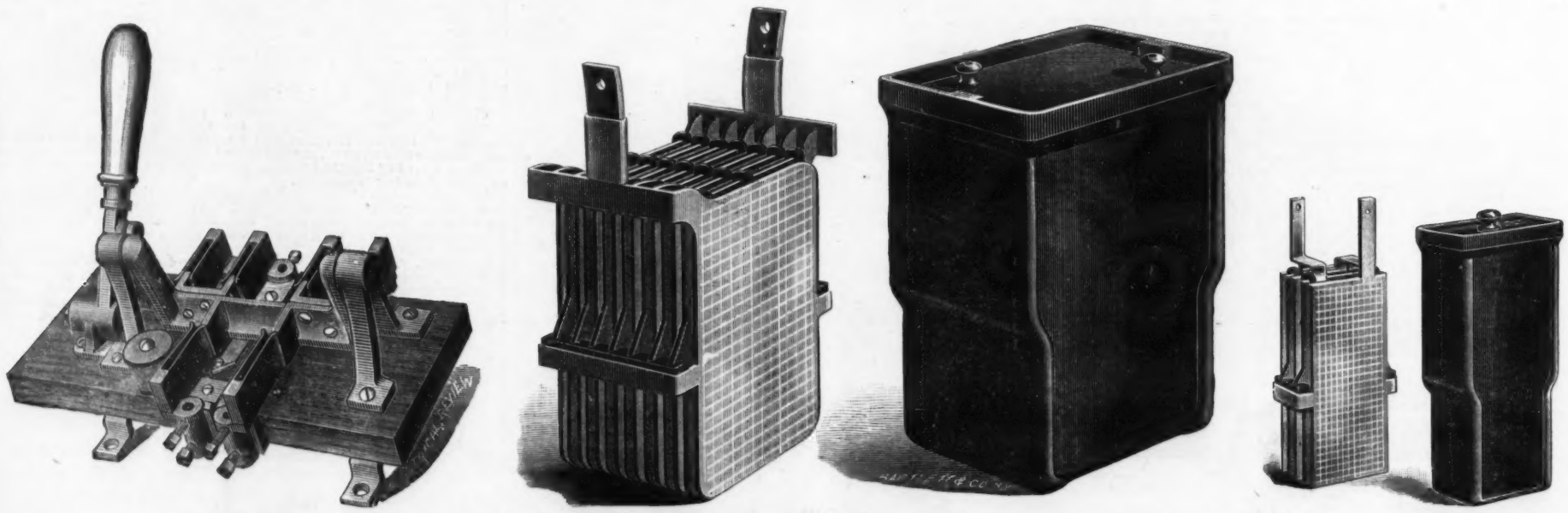


Fig. 15

FIG. 15.—SOME METHODS OF REGULATING ACCUMULATORS IN ELECTRIC LIGHTING.



FIGS. 13, 19 AND 21.—SOME METHODS OF REGULATING ACCUMULATORS IN ELECTRIC LIGHTING.

battery is equally simple, for it merely consists in adding to, or subtracting from, the number of active cells in circuit. This is accomplished by means of a multiple-point switch, called a cell-regulating switch, shown diagrammatically in Fig. 2, which is so constructed that, in the act of shifting the cells in and out of circuit, it neither interrupts the circuit nor short-circuits the cells. It consists essentially of a single pivoted lever, which carries on its outer end a short metallic arm. This arm is attached to the lever by means of a block of insulating material, but is electrically connected with it by a short spiral of German silver wire. The lever and arm may be made to pass over a number of contact strips, which are so arranged that, before the lever breaks contact at one strip, the arm comes in contact with the next strip, and the reverse action takes place when the lever is moved in the opposite direction. During the brief interval, while both lever and bar are in contact with adjacent strips, the cell connected to those strips discharges a feeble current through the spiral of wire.

It is necessary to mention here, that in practice it is customary to provide for the installation of 10 per cent. more cells in each series than a simple calculation on the basis of two volts per cell would show to be necessary. Thus a plant using 100 volt lamps would require $100 \div 2 = 50$ cells $+$ 10 per cent. of $50 = 5$, or 55 cells in each series. This allowance is usually sufficient to compensate for the fall of potential during discharge, as well as to provide for the ordinary loss of potential in the lamp main.

The method of employing the pressure equalizer and cell-regulating switch is shown in Fig. 3, this diagram being otherwise similar to Fig. 1, with the further exception that an automatic brake-switch, *B S*, is inserted in the branch wire connecting the dynamo and battery through the lower contacts of the switches S_1 S_2. The function of the automatic break switch is merely to interrupt the charging current, in the event of the potential of the dynamo becoming so much reduced from any cause as to allow the battery to overcome it, and perhaps reverse its polarity. This switch, a practical form of which is shown in Fig. 4, consists of a simple electro-magnet with a weighted armature lever carrying at one end an ∩-shaped bent wire dipping into mercury cups. The charging current passes through this magnet and from one mercury cup to the other through the bent wire. When the current becomes greatly reduced to any predetermined extent, gravity overpowers the attractive force of the magnet, its armature is released, and the bent wire being drawn out of the mercury cups, the circuit is broken. By referring to the diagram in Fig. 3, it will be seen that the pressure equalizer *P E* has been so placed that when the switches S_1 S_2 are on their lower contacts, the current from the (+) pole of the dynamo will divide at switch S_1, part going through the battery and part through the pressure equalizer to the lamp circuits, both currents again uniting at the *M* (−) main to return to the (−) pole of the dynamo. By this arrangement the potential of the dynamo may be adjusted to the requirements of the battery, and at the same time the pressure at the lamps suitably reduced by adjusting the resistance of the pressure equalizer.

When the proper balance is once obtained, and by means of this apparatus it may be quickly and easily accomplished by one man, no further attention than would ordinarily be given to the dynamo would be necessary, for although the counter potential of the battery would gradually rise toward the end of the charge, and the current passing into the battery become correspondingly reduced, this result is even desirable, as it is somewhat advantageous to reduce the strength of the charging current as the battery becomes filled. In some installations, however, the extra or regulating cells are used to a more limited extent than the others, and thus having had less current taken from them they become sufficiently charged in a shorter time. A simple movement of the cell-regulating switch will then serve to cut out of circuit one or more of the charged cells as may be required, while the others receive current for a longer time. In some cases a further adjustment of the field rheostat of the dynamo and of the pressure equalizer may afterward be required, and if so, are quickly effected.

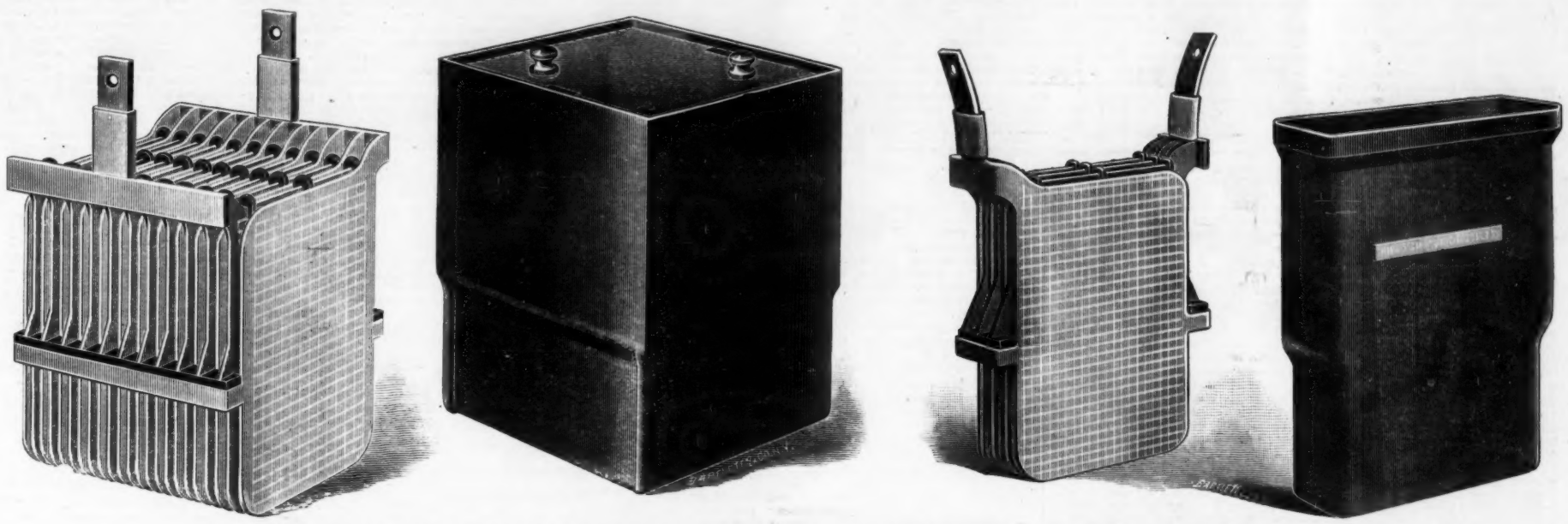
The first indication that the cells have received nearly enough charge will be given by the gentle evolution of gas, which gradually increases thereafter, and which should never be allowed to become violent. At the same time the potential of the battery will approach 2.2 volts per cell, and even reach above 2.3 volts per cell when the gasing becomes marked. In order to take advantage of this indication of charge it will be sufficient to have a voltmeter conveniently located and connected with the terminals of the battery, by means of which instrument, the number of cells in the battery being known, the potential per cell is readily ascertained. While this increase in potential is taking place, a similar variation in the density or specific gravity of the electrolyte in the cells also occurs, but this change, unlike that of the potential, remains fixed, even after the charging current is discontinued. That is to say, if the specific gravity of the liquid was 1.160 when the cells were normally discharged, it would rise to 1.190 when they were fully charged, and would remain at that for a considerable length of time if no current was drawn from them. This rise of 0.030 in the specific gravity of the electrolyte is about the average increase in density which takes place in the common types and sizes of accumulators when 1.160 acid is used in the original charge, and when the range is from the normal discharge to full charge. It often happens, however, that charging is commenced when the cells have more or less residual charge, and in this case the rise in specific gravity will be correspondingly less; while on the other hand it will be correspondingly greater if the cells were previously over-discharged. Again, if unusually large cells enclose the piles (as the aggregation of electrodes is commonly designated) the rise of specific gravity will be smaller, and, on the other hand, larger if unusually small containing cells are employed. As heretofore stated, a similar drop in specific gravity and potential occurs when the cells are discharged, which in degree has about the same value as the rise. This variation in specific gravity is explained by the formation of lead sulphate during discharge, which implies the absorption of acid from the electrolyte, and by the reduction of this sulphate during the charge when the electrolyte is strengthened.

While the method of installing a single series of accumulators in connection with an isolated plant, as described and illustrated in Fig. 3, fulfills most of the conditions required in small plants operating a single dynamo, in larger plants or a similar type using two or more dynamos, several series of the largest cells may be required. Although such an installation would consist mainly of an amplification of the system already described, still there exists a new difficulty not met with in that system. This arises from the fact already mentioned, that when several series of cells are charged in parallel, any essential difference in the amount of the residual charge in the several series results in their allowing different amounts of current to flow through them, although all of the series are charged at the same potential. The remedy for this undesirable result is of the same character as that employed to prevent excessive pressure on the lamp circuits, when the dynamo which supplies them with current is at the same time used to charge accumulators. In circuit with each series of cells is placed a small adjustable resistance coil, called a current equalizer, a cheap practical form of which is shown in Fig. 5. It is composed of wire large enough to carry the maximum current of a single series of cells, and usually has a resistance of from 3-10 to 6-10 of an ohm. Each series of cells is also provided with an ammeter, and upon the commencement of a charge the current equalizers are so adjusted that each ammeter shows the same amount of current to be passing through each series. In order to avoid as much as possible any loss of energy in the current equalizers, they are all turned to the no-resistance point at the start, and resistance is then only inserted in such series as may be taking more current than others.

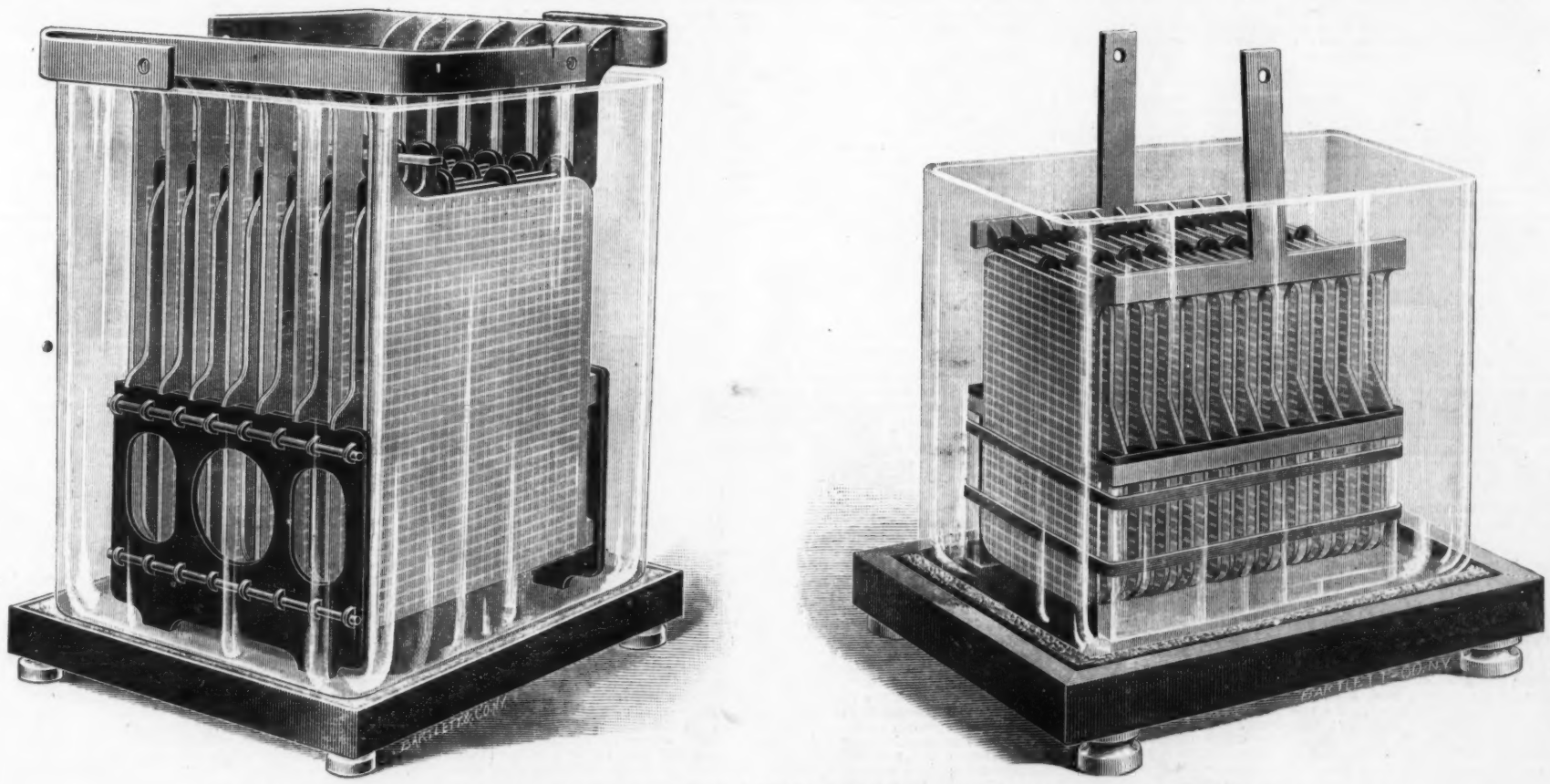
The general arrangement of an accumulator plant consisting of two dynamos and two sets of batteries is illustrated in Fig. 6, and a simple extension of this plan only is necessary to adapt any number of series of cells to a plant having any number of dynamos. It will be seen that one equalizer circuit, and one charging circuit with its automatic cut-out, are common to all the dynamos that may be used. While this arrangement possesses all the flexibility of the method of installing a single series of cells as shown in Fig. 3, it has the additional advantage that at such times as the load is below normal, a spare dynamo can be exclusively employed for charging the cells, and thus avoid loss of energy in the pressure equalizer. As a general thing, when the current equalizers *C E* have once been adjusted at the beginning of a charge they need but little if any further attention; still if from any cause one series of cells should happen to be overdischarged, or discharged more than the remaining series, a suitable readjustment of the current equalizers will permit the undercharged series to receive current at a higher rate than the others, and thus equalize itself with the others. It may also be mentioned that both the pressure and current equalizers may be made to operate automatically by the application of a potential magnet to the former and of a current magnet to the latter, together with a simple but somewhat expensive train of gears to move their levers. This is found to be wholly unnecessary in practice, however, as an engineer is usually in constant charge of such a plant while the dynamos are running, and he can easily devote the little time necessary to the infrequent regulation required.

It was mentioned in the early part of this paper that it was possible to injure accumulators either by overdischarging them or working them at too high a rate. It is assumed that in the larger plants, there will be such supervision available under ordinary working conditions that occurrences of this kind will be avoided; but a simple device for preventing such abuse of the cells in smaller plants, where such supervision is not always convenient has been devised. It is called an overload and overdischarge switch, and its operation is based on the fact that, when a series of cells is overdischarged, their potential falls below a minimum value, and that when they are worked above their normal rate the current exceeds a maximum value. The apparatus consists essentially of a pressure magnet connected to the terminals of the battery, and of a current magnet in series with the battery. When the potential of the battery falls below a minimum value, the armature of the potential magnet is released and throws an artificial resistance into the battery circuit, and thus reduces the current; and similarly, when the current exceeds a maximum value, the armature of the current magnet is attracted and performs a similar function. The connections of this overload and overdischarge switch *C* and *P* are shown diagrammatically in Fig. 7, in which a common resistance *R* serves for either magnet. The battery current passes from *A* to *B* through the overload magnet, while the terminals of the overdischarge magnet are, as before stated, in shunt to the battery terminals. In Fig. 8 is illustrated a practical form of a combined overload and overdischarge switch.

With the object of reducing the cost of the regulating apparatus whenever both the combined overload and overdischarge switch



FIGS. 18 AND 20.—SOME METHODS OF REGULATING ACCUMULATORS IN ELECTRIC LIGHTING.



FIGS. 16 AND 17.—SOME METHODS OF REGULATING ACCUMULATORS IN ELECTRIC LIGHTING.

and the current equalizer are to be used with the same series of cells, the switch portion of the equalizer may be mounted on the resistance frame, and thus a single resistance coil be made to do service for both instruments. This combination, of which the connections are shown in Fig. 9, while allowing the current equalizer switch to control the full range of resistance, at the same time causes the whole coil to be thrown into the battery circuit upon the operation of either the overload or overdischarge switch. This, of course, diminishes the brilliancy of the lamps, and thus indicates the state of affairs to those interested.

In applying accumulators to plants operated on the three-wire system, a simple extension of the method already described is adopted, except in the case of small stations requiring only one series of accumulators, and where the working circuits can be multiplied during the light load, so that the ordinary method will suffice. In larger plants the batteries are installed in pairs, each series having the same apparatus as before; and as this has already been fully explained, it will only be necessary to add that in adapting two series of cells to the three-wire system, the two batteries are connected in series in the same manner that the dynamos are connected. The general plan of this arrangement is shown in Fig. 10, from which unimportant details have been omitted. At the top of this diagram the three horizontal lines M (+), M (±), and M (−) represent the omnibus wires in the dynamo room, from which the feeders L are led. The three vertical lines O (+), O (±), and O (−), are extensions to the omnibus wires to which the dynamos are directly connected in the usual manner when the levers of the switches S_1 are on their upper contacts. The batteries are also connected with the omnibus wires in a similar way, so that when the switches S_2 are closed on their lower contacts the batteries will also discharge into the lamp circuits in parallel with the dynamos. Now if the switches S_1 are turned to their lower contacts, and the switches S_2 to their upper contacts, the current from the dynamos will divide at the switches S_1, part going into the lamp circuits, and part through the batteries, which thus receive a charge. As in the multiple arc system, the potential of the dynamos being assumed to be raised above the normal to meet the requirements of the batteries, in order to suitably reduce the pressure on the lamp circuits, it is only necessary to adjust the resistance of the pressure equalizer P E. In central stations, where the feeders are already provided with pressure equalizers, the connections are still more simple, for the batteries are merely connected to the omnibus wires, while all other connections of the ordinary three-wire station are unchanged. In such cases, the increased pressure at which the dynamos are operated during the time the batteries are charging is reduced at the lamps to the proper point by the usual adjustment of the feeder or pressure equalizers. During the charging period all regulation of the accumulators may be dispensed with by opening the switch S_1, when both batteries will be connected in a single series to the full pressure of both dynamos. In addition to the apparatus shown in the diagram, each series of cells is provided with a double plug switch and sockets suitably disposed, by means of which the relative positions of the batteries on the two sides of the system may be changed by simply transposing the plugs from one socket to the other. The object of this arrangement is to provide means for compensating for the unequal discharge of the batteries when the two sides of the lamp system are unbalanced; and the transposition is never made oftener than once each day. In all other respects the manipulation of accumulators when applied to three-wire systems is practically the same as when they are operated on the multiple arc plan. To increase the accumulator capacity of three-wire stations, double batteries are added in parallel to the first set, just as additional dynamos would be.

It was explained further back that the extra, or regulating cells in each series often become charged sooner than the remainder of the cells, and required to be removed from the circuit before the others. This operation, of course, calls for some labor; and, little as it is, it would still be desirable to have the number of cells in a series remain fixed both during charge and discharge. By the use of what are called counter electromotive force cells, this result may be effected, and at the same time the pressure equalizer be dispensed with. These very simple cells are made like an ordinary Planté accumulator of plain sheets of an inoxidizable lead alloy and without active material. When a current is passed through them they act as gas voltameters, and while they instantly oppose a counter electromotive force of about two volts, they are incapable of producing a current of any appreciable amount of duration on account of their inoxidizable property. The use of counter electromotive force cells in place of equalizers is advantageous in several ways, for not only may their internal resistance be made so small as to be practically negligible, but their counter electromotive force is as effectual in reducing excessive pressure as a dead wire resistance, while possessing the unequaled advantage that he fall in potential of the current passing through them is unaffected by any variation in the strength of such current.

The method of using these counter electromotive force cells is shown in Fig. 11, which represents a single series of accumulators installed in connection with a direct lighting plant operating one dynamo, as first described, and for simplicity and effectiveness this method cannot be well exceeded. The dynamo is connected to the lamp mains, as before, through an ammeter on one side, and through the upper contact of a two-way switch S on the other; while the battery B is similarly connected to the lamp mains on one side, but on the other the circuit is completed through several counter electromotive force cells K_1, the number opposed being governed by the position of the cell regulating switch C S. When the lever of switch S is on its lower contact, the charging circuit is completed in the now familiar manner. The action of a plant arranged in the above way is as follows: Assuming the lever of the cell-regulating switch to be turned off or open, as the expression goes, and that the dynamo switch is on its upper contact, the dynamo alone supplies current to the lamp circuits. If, now, the lever of the cell-regulating switch is turned to its left hand contact plate, the battery will be similarly supplying current to the lamp circuits in conjunction with the dynamo, or alone if the dynamo switch is opened. If the dynamo switch is now turned to its lower contact, the dynamo current will divide at the point where it connects between the battery and counter electromotive force cells, part going through the battery and back to the dynamo through the (−) lamp main, while the remainder will pass through the counter electromotive force cells to the lamps. Thus, while the full pressure of the dynamo current will be effective at the battery terminals, its pressure at the lamps will be less by 2, 4, 6, etc., volts, according as 1, 2, 3, etc., counter electromotive force cells are opposed to the passage of the current into the lamps by the position of the lever of the cell-regulating switch.

When the battery has been fully charged and it is desired to stop the dynamo, the latter may be disconnected by opening the switch S_1, when the battery alone will maintain the lamps. As previously explained, the potential of the battery will be a maximum immediately after it has received a charge, so that in this case, if the battery has the usual allowance of extra cells, its potential will be higher than the lamps require. More or less of the counter E. M. F. cells may now be inserted in the lamp circuit, however, until the potential is suitably adjusted. Although during the greater part of the discharge the E. M. F. of the battery will remain fairly constant, if discharged to its limit the potential will slowly fall toward the end, and this fall must be compensated for by removing one or more of the counter E. M. F. cells from the lamp circuit.

It is to be noted that by means of the above method, the number of cells in the battery proper is fixed and unalterable during both the charge and discharge, and that whenever the dynamo is supplying current to the lamps, its surplus current is always available for charging the battery; moreover, only one adjustment of the counter E. M. F. regulating cells opposed to the lamp current will be required. It is obvious that counter E. M. F. cells may be substituted with equal effectiveness for the equalizers and regulating cells employed in all of the previously-described systems, and it seems unnecessary to go into any further particulars in order to illustrate the practicability of such systems when properly installed and operated.

We have now to consider another branch of the electric lighting business, in which accumulators also claim a share of attention, viz., the supplying of current to lamps located at a considerable distance from the source of power.

The first method to be considered is known as the half-direct plan, in which one or more series of cells are installed in any number of sub-stations conveniently located near centres of lamp consumption. The charging station may be situated wherever economy dictates, without any special reference to the location of the batteries, for although the expense of the charging wire and the cost of the energy wasted in it cannot be neglected, both these factors must be offset by the saving effected from locating the power station in the most desirable situation. This half-direct system is so called because during the period of maximum load half the current is supplied by the charging dynamo, and half by the batteries. At other times the dynamo may be simultaneously charging the batteries and supplying lamps, or the battery alone may be in operation. Each sub-battery station is, in fact, a small central station by itself, and it may contain one or several series of cells, the number, of course, depending upon the amount of lighting to be done in its vicinity. A common charging main, like an arc light circuit, passes through each sub-station, and each battery may be inserted in the main or withdrawn from it at will, exactly as arc lamps are cut in and out of circuit. The charging dynamo is usually of high voltage and of moderate current capacity. Machines of 500 volts and 15 amperès to 1,200 volts and 40 amperès may be employed in small stations, while in larger ones the latter machines and their circuits may be multiplied. For charging purposes shunt-wound dynamos are preferable on account of their non-reversibility, but even series and compound wound machines may be used if suitable precautions are taken. The arrangement of the accumulators and regulating apparatus in each sub-station on the half-direct system is essentially the same as the method adopted in the last described multiple arc system. The connections of two sub-stations installed on this plan are shown in Fig. 12, in which station 1 is shown with its switches in position for both its battery and lamp circuits to receive current from the charging circuit; while station 2 is disconnected from the charging line, which is closed outside of it, and the batteries alone supply the lamp circuits. The switch which is employed to throw the batteries into, and out of, the charging circuit is of the snap action type, and is sometimes called a consumer's switch. It maintains the integrity of the charging circuit when the batteries are removed from it, and is provided with a spark coil which prevents the opening of the charging line and the consequent formation of the injurious arc which results on the interruption of high potential circuits. A modified practical form of this switch is illustrated in Fig. 13. As shown diagrammatically in the sketch, it consists in the main of four terminal contact springs, which bear against an insulated cylinder in which are imbedded two rows of metallic contact strips. In one position the two left hand and the two right hand springs are brought into electrical contact, but if the cylinder is rotated slightly the two middle springs will be brought into electrical contact, while the two outer ones are left free, as shown respectively at R and R_1. As before stated, this change is effected rapidly and without breaking the circuits. These switches are usually operated by hand at the beginning and end of a charge, at which time whatever inspection of the cells is necessary is also generally made. By applying the polarized magnet principle to this switch it can be made to operate automatically from the central station through a momentary reversal of the charging current, a principle which has already been applied.

While the method just described of locating the batteries in sub-stations near the lamps to be supplied reduces the resistance of the supply wires to such an extent that the variation of potential with changes in current strength is unimportant compared with what it would be were all the lamps operated from one central point, under ordinary conditions, still a similar variation does occur from a different cause. We have already seen that the potential of a battery is higher while it is being charged than at other times, and that the greater the charging current the higher the potential of the battery becomes. It is evident that if charging commences when only a very few lamps are burning in a given battery only a small part of the charging current will be required by the lamps, while the greater part will pass through the battery. This will raise the potential of the battery considerably, and as the lamp mains are permanently connected to its terminals, the lamps will receive an excessive pressure. As the number of lamps increases, however, more of the charging current will pass to them and less through the battery, the potential of which thus becomes gradually reduced until it reaches a minimum, when the number of lamps burning becomes so great that the whole output from both the dynamo and battery is required to maintain them. The variation is in the opposite direction, of course, when the lights are diminishing in number. It is evident from the preceding facts that during the period when the charging dynamo is running and the lamp loads are varying some regulation of the pressure at the lamps mains at each sub-station is required. This regulation is automatically effected by means of the apparatus shown in Fig. 14, in which a solenoid magnet, A R, and a polarized magnet, P M, are inserted in the battery circuit, In all other respects the ralative positions of the battery, lamps and charging circuits remain unaltered from the arrangement shown in the last diagram. The operation of the apparatus in this sub-station will be as follows: Assuming the charging dynamo to be delivering a current through the charging main M, and that the consumer's switch is in the position shown in the diagram, the charging current will pass from M (+) to the point Q, where it will divide, part going through the lamps and the opposed counter electromotive force cells K to the point L, and thence to the line again, the remaining part of the current passing from point Q through the magnets P M and A R, and out through the battery to point L and line, When the current is nowing in the direction of the arrow, as in the case just cited, the armature of the polarized magnet is moved to its left-hand contact, as shown, and the plunger of the solenoid magnet is more or less drawn down, according to the strength of the current. This action of the solenoid magnet causes one or more counter electromotive force cells to be inserted in the lamp circuit in such a way as to oppose their electromotive force to that of the charging current, while the full pressure of this current is available at the battery terminals. If now the number of lamps is increased to such an extent that not only all of the charging current passes through them, but also that more or less current from the battery joins in parallel with it, then the current from the battery will traverse the polarized magnet in the opposite direction from that previously taken by the charging current, and its armature will be moved against its right-hand contact, thus short-circuiting the solenoid magnet and the counter electromotive force cells, as indicated by the broken line. For, as the sketch shows, the lever of the solenoid magnet is so balanced that when no current is traversing the magnet, its metallic contact rods all dip into their respective mercury cups, and so shunt around the counter electromotive force cells with which the latter are in electrical connection. When the lamp load becomes reduced and the charging current is discontinued either by the stoppage of the dynamo, or by its being shunted past that particular battery by a movement of the switches to the right, the battery alone works into the lamp circuit, and the counter electromotive force cells are short-circuited.

While the automatic regulator just described, when applied to the half-direct system, maintains the pressure at the lamps sufficiently uniform for practical purposes, whether the charging dynamo is operating or not, and although the proximity of the battery to the lamps it supplies prevents undue variation of potential when the load changes, yet a perfectly automatic method of maintaining a constant potential at the lamp circuits, even where the resistance of the leads is great, would be generally useful. Such a method is illustrated in Fig. 15, in which the battery, counter electromotive force cells, lamps and charging circuits, occupy the same relative positions as before. The solenoid magnet of the regulator is no longer in series with the battery, however, and is, in fact, entirely disconnected from it, while the polarized magnet is replaced by a second solenoid magnet, P M wound to high resistance. The armature lever of this second solenoid is so mounted that when its core is attracted or released this lever moves over a series of contact strips which are insulated from each other. Connected with these contact strips are coils of wire of suitable resistance, the whole constituting a simple rheostat-more or less of the wire of which is included in a local circuit, according to the position of the lever, which acts as a movable contact. The solenoid magnet of the regulator A R, and one or two cells of accumulators, are also included in the local circuit referred to, the strength of the current flowing in this circuit depending upon the amount of resistance inserted by the movement of the lever of the pressure magnet P M. The latter magnet is connected directly with the battery terminals, and as the potential of the battery rises and falls, the current flowing through this magnet varies correspondingly, causing a similar variation in the current in the local circuit. Thus an increase of pressure at the lamps which are connected to the battery terminals indirectly causes the armature of the regulating magnet A R to be attracted, and this in turn opposes one or more counter electromotive force cells in the lamp circuit until the pressure again becomes normal. If the pressure at the lamps falls below normal, the regulator acts in the reverse way, cutting out the counter electromotive force cells until the normal pressure is again restored. If in connection with this method the polarized consumer's switch, previously mentioned, is substituted at S, the operation of such a sub-station will be entirely automatic.

It is proper to mention that the pressure magnet must be very sensitive and requires a delicate adjustment, besides being somewhat costly on account of the excellence of the workmanship required. Although I have only seen the instrument used in an experimental way, its practical application to similar purposes has given satisfactory results.

Under certain circumstances, as, for example, when a lighting station is worked to its full capacity at night, but during the day time has ample surplus power, the all-accumulator system may often be applied to increase the capacity of such a station with satisfactory results. In such cases the sub-stations of accumulators are located at distant points in the usual way, the cells being charged during the day and discharged on the lamp circuits at night while the power plant is doing its regular work. The arrangement of the accumulators and regulating apparatus in the sub-stations of the all-accumulator system is practically the same as when the half-direct system is employed, except that a single transfer switch, which transfers the battery from the lamp circuit to the charging circuit, and *vice versa*, is used instead of the consumer's switch.

It is needless to say that all of the methods which have been described of employing accumulators in long-distance lighting may be adapted to existing lighting plants, and that when so adapted the earning capacity of such stations may be considerably increased without extending the capacity of the power plant. For this purpose there will usually be required a special dynamo at the central station, a charging circuit taking in the territory outside of the regular lighting limits, and one or more sub-stations with accumulators.

There are, of course, numerous other ways of utilizing accumulators in central station supply systems, such, for example, as the double battery method now operated in England by the Electrical Power Storage Company, in which the dynamos are kept running for 24 hours daily, duplicate sets of accumulators being alternately inserted in the charging and supply circuits at uniform intervals of time, by an automatic mechanical device. But I have limited this paper to a description of some of the simpler methods of accumulator regulation which may be readily adapted to ordinary lighting plants, and, in concluding, can only hope that I have succeeded to some extent, at least, in showing that when so applied in an intelligent manner accumulators do occupy a useful place in the industry of electric lighting.

Through the courtesy of the Electrical Accumulator Company I am enabled to present to the Institute this evening the first proofs of some cuts of a new line of standard accumulators recently brought out by that company. The cells referred to are shown in Figs. 16 to 21, inclusive, and their dimensions and capacities are described in the table herewith.

LIST OF ELECTRICAL ACCUMULATOR COMPANY'S STANDARD CELLS.

(Approximate data.)

Figure.	Type of cells	Charging current. Normal. Ampère.	Working rate and capacity. Ampères. Normal. Rate.	Normal. Ampère hours.	Maximum. Rate.	Maximum. Ampère hours.	External dimensions of jars. Inches. Glass. Length.	Glass. Width.	Glass. Height.	Rubber. Length.	Rubber. Width.	Rubber. Height.	Weight of acid. Lbs. Glass.	Weight of acid. Lbs. Rubber.	Weight complete cell. Lbs. Glass.	Weight complete cell. Lbs. Rubber.	Height over all, including connections. In.
16.	15 L.	15 to 30	30	300	40	250	10 3/4	12 1/4	13 3/4	.....	.....	.....	50	.....	130	.....	15 1/2
17 & 18.	23 M.	10 to 25	25	150	30	110	10 1/2	8 1/2	9 7/8	6 3/4	7 1/8	9 7/16	16	11	50	40	11 1/2
19.	15 M.	5 to 15	15	100	20	70	7 3/4	8 1/2	9 7/8	4 5/8	7 1/8	9 7/16	11	7	35	25	11 1/2
20.	7 M	2 to 6	6	40	8	25	4 3/4	8 1/2	9 7/8	2 5/8	7 1/8	9 7/16	6	3 1/2	20	13	11 1/2
21.	5 S.	1 to 2	2	8	3	6	.....	.....	...	1 7/8	3 3/8	6 9/16	.....	1/2	.....	2 7/8	7

E'ectromotive force of each cell is about 2 volts.

Improvements in Electric Train Lighting.

Mr. A. H. Bauer, manager of the electric lighting department of the Pullman Company, has just completed the electrical equipment of the handsome "Montezuma" special, a train of four improved Pullman vestibuled cars that are now on exhibition in Chicago, preparatory to being taken over the famous "Monon Route," via Louisville and Chattanooga, to New Orleans, and thence to the City of Mexico. Every modern device or improvement that will add to the comfort of the tourist or invalid can be found in the drawing-room car, which is most appropriately named the "Superb." It contains six complete drawing rooms, each provided with separate annex for toilet purposes and separate entrance to the side passage; or the rooms may be used *en suite* for large parties, allowing an aisle from end to end through centre of car.

It is the first car of this plan ever constructed, and the finishing and fitting are of the highest order of excellence. The drapery and decorations in each drawing room are different, while all are in harmony with the exquisite taste everywhere displayed. Mr. Bauer has placed 39 sixteen-candle power Edison lamps in the "Superb," arranged on two distinct circuits termed the "end circuit" and the "body circuit," running directly from the cells to a switch and cut-out case placed within a convenient locker and holding the four safety strips. This arrangement permits of easy and economical handling of the all-night lights in the vestibule and toilet rooms. Each lamp is also supplied with a key socket, so that a particular light may be turned down by the occupant of a berth, while in the corner of each section silvered thimbles have been placed in which may be inserted a portable lamp with frosted bulb connected to the branch wires by means of a flexible silk cord the terminals of which are inserted into sockets placed in a rosette above the section mirror, thus affording any desired angle of light should the occupant prefer to read while reclining. Mr. Bauer has so placed the lamps in the composite car and in the dining car that the light falls directly from above and over the shoulder of the tourist, while fans revolved by electric motors are furnished when desired by invalids or others, the motor being connected in the same manner as the portable lamp.

The electric current is supplied by two sets of storage batteries placed underneath and on each side of each car in the train. The new type of cell, 23 M, made by the Electrical Accumulator Company of New York, is employed, and it is charged with current from an Eickemeyer dynamo driven by a Brotherhood engine, This plant is placed in one corner of the composite car and includes an automatic lubricator holding two gallons of oil, steam gauges, voltmeter, ammeter, and a Schaeffer & Budenberg tachometer, as furnished on all the Pullman trains. Speaking of the excellent service given by the Eickemeyer dynamo and of the slight attention required, Mr. Bauer stated that the machine, now in service, had been run continuously for five months with an overload, and yet there had not been the slightest sparking at the brushes or trouble of any sort. The present machine gives 90 volts and 85 ampères at exactly 850 revolutions. Mr. Bauer will accompany the Montezuma special on her maiden trip as far as New Orleans and probably through to the City of Mexico and return.

Meeting Mr. Bauer on his return from an inspection of the special train occupied by the Pan-American delegation, he referred to the question asked by Mr. A. L. Lang at the meeting of the railway telegraph superintendents, a full report of which appeared in The Electrical World of Oct. 26, regarding the belting of the dynamo to the axle, and stated that a thorough experience under various conditions had demonstrated the impossibility of securing even fair results in train lighting where the power was supplied by the axle, owing to the constant change in speed and the numerous curves found on American railways, around which the wheels will often slide without turning the axle a single revolution, thus playing the mischief with belt and armature. But Mr. Bauer said that such a method was employed by Mr. H. O. Houghton in securing current for the train lighting on the London & Southwestern Railway in England. During a trip over that line Mr. Bauer was impressed with the conditions tending to make the system a success, and which are widely different from those prevailing in this country, in the almost entire absence of curves and the high and constant speed maintained, made possible by the fact that that railway never crosses a country road at grade, being either below or above. When the speed does vary, an automatic switch placed near the dynamo cuts out the cells, which are not distributed under each car as in the Bauer system, but all are placed in the baggage van, such disposition being made possible by the fact that English passenger trains are seldom or never "broken up" or separated; while here it rarely happens that any two coaches are used on the same run for more than two or three trips, necessitating the employment of a distinct set of cells under each coach in order that light may be

furnished regardless of whether the baggage car contains a charging equipment or not.

Mr. Bauer paid a high compliment to Vice-President Thomas H. Wickes, of the Pullman Palace Car Company, to whose energetic, progressive action, coupled with a generous allowance for experiments, is due the remarkable success attained by the Pullman Company in train lighting. F. DE L.

Government Telegraph Rates.

Postmaster-General Wanamaker has now established the following rates for telegraph messages received by the different companies to be transmitted at the government's expense:

For day messages, containing not more than ten words, exclusive of place from, date, address and signature, ten cents for all distances not exceeding 400 miles, and one-half cent for each word in excess of ten words.

For distances exceeding 400 miles and not exceeding 1,000 miles, fifteen cents for the first ten words counted as above provided, and three-fourths of one cent for each word in excess of ten words.

For all distances exceeding 1,000 miles there shall be added to the price of the message fixed for distances of over 400 and under 1,000 miles the sum of one-half cent for each word counted as above provided.

In cases where the price of a message determined as herein provided shall include a fraction of a cent, such fraction, if less than one-half, is to be disregarded; if more than one-half, it is to be counted as one cent.

For night messages, if not exceeding twenty (20) words, exclusive of place from, date, address and signature, fifteen (15) cents for all distances, and one-half (½) cent for each additional word.

On a New Form of Current Weigher.*

BY PROF. JAMES BLYTH, M.A., F.R.S.E.

In the construction of balances for the measurement of electric currents a greater or less difficulty has always been experienced in leading the current into the movable parts of the instrument without seriously interfering with its sensibility. Several methods have been adopted to overcome this difficulty. In some balances the current is led in by mercury cups: in others, flexible leads, made of thin wire spirals or thin metal strips, are employed; while, in there ampère-balances by Sir William Thomson, the difficulty has been overcome by means of his well-known ligature suspension.

Some time ago it occurred to me that still another form of balance might be employed for this purpose, and the

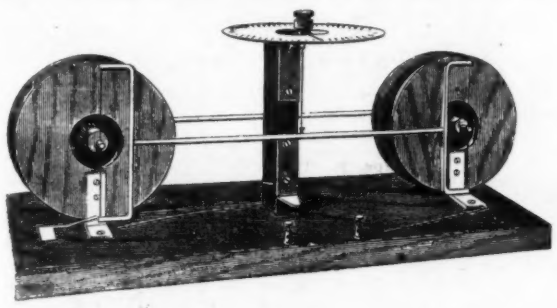


FIG. 1.—BLYTH'S NEW CURRENT WEIGHER.

present paper is a short description of one which I have made.

The balance referred to is of the ordinary Roberval type, with the pivot connections all replaced by tightly stretched torsion wires.

It is constructed as follows:

On a flat baseboard, Fig. 1, are placed two vertical uprights of wood or other insulating material, about six inches apart. Between these are stretched two parallel wires in the same vertical plane, about three inches apart. To the middle points of these wires are soldered the two horizontal metal bars of the Roberval.

These are about nine inches long. Both horizontal bars terminate at each end either in forks or rings, placed in a horizontal plane, and wires are tightly stretched between the prongs of the forks, or across a diameter of the rings. To the middle points of these last wires are attached, also by soldering, the vertical bars of the balance, thus completing what takes the place of the ordinary jointed parallelogram of the Roberval.

The vertical bars have metal terminals, insulated from each other, and carry the circular discs, on the rims of which the movable coils of wire are wound. The bars pass at right angles through the centres of the discs, and are fixed to them at their middle points. The fixed coils which are of exactly the same diameter as the movable ones, are supported from the baseboard, and are placed so that one is about half an inch above one movable coil, while the other is as much below the other movable coil. From this it will be seen that when the balance is in equilibrium the fixed and movable coils are all horizontal, with a space of about half an inch between each pair.

The stretched wires may be either of steel or phosphor bronze, and before being finally soldered are placed under considerable tension.

The current flows through the instrument thus: Entering, say, by the upper wire connecting the fixed supports, it passes to the upper horizontal bar. There it splits into two, one-half (supposing the resistances equal) passing to each end of the bar, and, by means of the corresponding fork-wires, passing through the movable coils. From the movable coils each half returns along the lower horizontal bar, and together pass out by the lower wire connecting the two main supports. From this the whole current passes first through the one fixed coil and then through the other, and in such a direction as to produce a repulsion between each pair of coils.

In the constructing care is taken that the suspended coils are both made of equal weight, and that when the balance is in equilibrium no torsion is in any of the wires. Small scale pans are attached to each vertical bar, and a bob for raising or lowering the centre of gravity of the whole is placed on a rod springing at right angles from the middle of one of the horizontal bars.

The current strength is estimated by the weight needed to restore the balance to equilibrium when disturbed by the passage of the current. A sliding weight may also be used as in a steelyard.

It will be readily seen that, as in all forms of current weigher, the weights are proportional to the square of the current strength.

Another form of the instrument, which is in reality a torsion balance, is represented in Fig. 2. It differs from the previous form in this, that all the coils are in a vertical plane with the torsion wires, also vertical, while the current is measured by the number of degrees of torsion that must be given to one end of one of the torsion wires in order to bring the balance to equilibrium. If the connections be considered, it will be seen that no current passes through the wire whose torsion rigidity is used to measure it, and also that the current is so distributed among the other wires that only one-fourth of the heating effect is

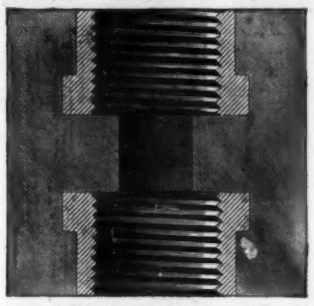


FIG. 1.—THE ERICKSON INSULATING COUPLING.

produced in each of them which would be produced if the entire current went through them. In this way the want of accuracy due to any heating of the wires is reduced to a minimum. The balance exhibited, though only a model, has a resistance of 360 ohms, and is quite sensitive to currents of one-tenth of an ampère.

*Read at the Newcastle meeting of the British Association.

The Erickson Coupling for Combination Fixtures.

Where combination gas and electric light fixtures are employed it is essential for safety from grounds and leaks to insulate the fixture from the gas pipe or suspension rod. In order to accomplish this in an effective manner, the Erickson Insulated Coupling Company, of Boston, Mass., have recently brought out the insulating coupling shown in perspective and in section in the accompanying illustrations. As will be seen, it consists of two threaded brass couplings firmly imbedded in an insulating material having a tensile strength of two tons to the square inch. The coupling is in the shape of a hexagonal nut and can be applied with a simple wrench. The coupling is made with a passage through the centre for the gas, but for connecting electroliers the brass couplings are separated by the insulating partition, which is made solid. These couplings are made in all sizes and are not affected by gas.

In a recent test an anvil weighing 350 pounds was suspended from an Erickson coupling (by means of a gas pipe screwed into either end), and then struck with a 20-pound sledge hammer without damaging the coupling.

Visit to the Thomson-Houston Factory at Lynn by New England Cotton Men.

On the invitation of Mr. H. C. Spaulding, general manager of the Thomson-Houston Motor Company, the members of the New England Cotton Manufacturers' Assoociation paid a visit to the Thomson-Houston factory at Lynn to investigate the wonders of electricity as a motive power. The semi-annual meeting of the association had been held the day previous in the Rogers Building, Massachusetts Institute of Technology, when a paper was read by Mr. W. S. Kelly, of Lowell, Mass., on "Cost of Long Distance Electrical Power Transmission." The following is a list of the gentlemen who visited Lynn under the able guidance of Mr. Spaulding: C. E. Riley, of Riley & Gray, Boston; George Wood, Philadelphia; George W. Weeks, Lancaster Mills, Clinton, Mass.; J. H. Sawyer, Chicopee Manufacturing Company, Boston; H. P. Sawyer, Boston; J. P. Woodberry, Boston; R. B. Borden, R. B. Borden Manufacturing Company, Fall River, Mass.; Ambrose Eastman, Secretary N. E. Cotton Manufacturers' Association, Boston; Arthur H. Lowe, Parkhill Manufacturing Company, Fitchburg, Mass.; A. S. Wattles, of L. R. Wattles & Co., Canton, Mass.; A. J. Gardiner and A. J. Gardiner, Jr., Danielsonville Cotton Company. Danielsonville, Conn.; T. P. Wattles, Suncook, N. H.; M. F. Foster, Denison Manufacturing Company, Milford, N. H.; S. M. Bourne, Stark Mills, Manchester, N. H.; F. F. Dwinell, Boston Manufacturing Company, Boston; S. S. Spencer, Lancaster, Pa.; John T. Meats, Mason Machine Works, Taunton, Mass.; Henry A. Davis, Kitson Machine Company, Lowell, Mass.; W. H. Martin, San Francisco; H. M. Patterson, C. A. Bowditch, E. W. Kellogg, George W. Mansfield and H. C. Spaulding, of the Thomson-Houston Company; C. A. Sawyer, *Boston Advertiser;* T. W. Sprague, Edward Caldwell and A. C. Shaw, representing the electrical press.

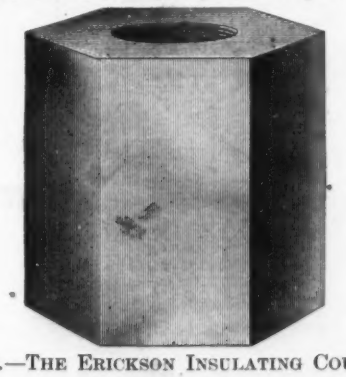


FIG. 2.—THE ERICKSON INSULATING COUPLING.

The party left Boston in a special car at 10:45 and made an exhaustive trip through the Thomson-Houston factory, the gentlemen showing much interest in the details of the dynamos, motors and generators, special attention being given to the work of transmission of power by electricity. Great satisfaction was shown at the extremely busy appearance of this department, and Mr. Spaulding was warmly congratulated upon his successful ventures in this line. A ride on the dummy line of cars, which are driven by an electric motor, and which transport all the heavy machinery from one part of the factory to the other, was thoroughly enjoyed. At two o'clock the entire party were driven to Earle's restaurant and partook of an excellent lunch, after which an enjoyable visit was made to the factory of the Thomson Electric Welding Company, the return to Boston being made about four o'clock.

Mr. Spaulding is meeting with great success in supplying mills and mines with the Thomson-Houston motor, and orders continue to flow in until the factory is pretty well taxed to keep abreast with them. Agents are being appointed all over the West, and this department now bids fair to rival in magnitude any of the other departments which have been longer in the field.

The Paris Exposition Award to the Julien Storage Battery.

Mr. William Bracken, the managing director of the Julien Electric Traction Company, has forwarded us the following:

We find in *L'Ingenieur Conseil* of the 12th inst., just received from abroad, and which, if you have not on file, you may see at this office, the following information in relation to the granting of prizes at the Universal Exposition at Paris for the different types of accumulators or storage batteries.

ACCUMULATORS AT THE PARIS EXPOSITION.

The official list of prizes distributed to exhibitors has just been published. We give herewith the Award of Merit which the Jury has assigned to the different manufacturers of accumulators:

Grand Prize.—M. Gaston Planté (deceased).

Gold Medal.—The Société L'Électrique of Brussels, who manufacture the Julien accumulators.

Silver Medals.—The Electric Power Storage Company (E. P. S. of London), which exploits the Faure-Sellon-Volckmar accumulators.

Silver Medal to the French Société of Accumulators (Phillip Bros.), who exploit in France the Faure-Sellon-Volckmar accumulators.

Silver medals were also awarded to M. Gadot, who also exploits the Faure-Sellon-Volckmar accumulators in France, and to M. Emile Reynier, who exploits accumulators of his own system.

The other manufacturers of accumulators obtained either bronze medals or honorable mention.

When we consider that the grand prize was given to M. Planté purely as an honor to the memory of a savant who

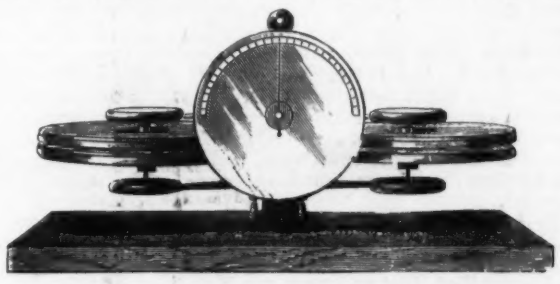


FIG. 2.—BLYTH'S NEW CURRENT WEIGHER.

in 1859 invented the secondary pile, the highest distinction was in reality granted to L'Electrique (or Julien) in this important branch of electricity.

Electrical Growth in the Great Northwest.

In the rush and excitement due to the enormous growth of the various electrical manufacturing and commercial interests in the Eastern cities, very little is generally known concerning the rapid strides being made by the Territories and new States in the West. This is particularly true of the extreme Northwest, which has the new State of Washington as a centre. We find that in that State there are a number of small, yet very precocious, cities of less than two thousand people, enjoying and utilizing to the fullest extent the incandescent light for interiors, and vying with each other in using the largest arc lights on the streets, perhaps in order to make the proper "boom" impression on the wary capitalists who come in on the night trains. We find the incandescent lights in the hotels and public buildings almost everywhere. In Seattle, the Queen City of Puget Sound (which was, by the way, practically destroyed by fire a few weeks ago) we find 120 acres of brick blocks in course of construction, the prices of bare lots in many instances being higher than when covered with good buildings before the fire. This city has an extensive and successful system of electric street railways, two cable railways in operation, and the third in process of construction. There are also three electric light companies and a prospect for yet another one. Electric motors are very generally being placed in the new buildings by the electric railway company, and the blaze of the electric lights and the hum of the motors are present everywhere.

Spokane Falls also comes in as an aspirant for honors in the electrical line and general improvements. She has a cable line, an electric railway and the most extensive stationary motor business of any city on the coast. The cable and electric railway and all the electric lights and motors are driven by water-power, which, by the way, the Spokanes claim to be the best all-round water-power in the world. The electric railway is about five miles of double track, with bracketed poles in the centre of the street, and in the business portion of the city the top of each pole is studded with a circle of five 16 c. p. lamps, which make a very pretty effect indeed. The Pullman people say that the electric cars for Spokane are the finest street cars, with one exception, that their factory has ever turned out.

Tacoma has in process of construction about seventeen miles of single track road; Victoria, B. C., is building five miles of road, and Vancouver, B. C., the same. Portland, Ore., has four roads under construction and negotiations are pending for still another. All of these roads are using the Sprague or Thomson-Houston overhead system.

Washington claims the honor of the first large railway tunnel to be lighted by electricity; this is the Stampede Pass tunnel on the Northern Pacific Railroad, which is

9,540 feet long and is fitted up with a 600-light Edison municipal plant, using water power, fed from melting snows from the mountain peak, for driving the dynamo. Portland, Ore., is being lighted by electricity brought from the falls of the Willamette River, at Oregon City, fourteen miles distant, and having as much as thirty-seven miles of wire in a circuit of arc lamps. Additional machinery is now being installed at these falls for driving a large number of motors in the city of Portland, and the promoters of the enterprise feel confident of replacing with them, at an early date, all the steam plants in the city.

Governor Miles C. Moore, the very enterprising executive of the new and enterprising State of Washington, has for lighting his handsome country residence a plant of ingenious design, and which has perhaps no counterpart. The plant consists of an 80-light Edison dynamo run by a water wheel about 2,000 feet from the residence. This wheel is fed by springs near the governor's house, the water supply at the wheel passing through the yard and being controlled from the house by a cord. To the wheel is fitted an ordinary "Snow" governor connected by gearing, and the dynamo is belted direct to the water wheel pulley. All running parts are made self oiling and the dynamo is so constructed that there is no change of lead of the brushes or sparking at the commutator under the extreme variations of load from all lights to none at all. There is a loss at full load of 15 volts between dynamo and the lights, and the peculiar part of the installation is that not only does the plant run itself, locked in the wheel house, and without attendance through the night, but by the application of a simple automatic, quick-acting and positive device the pressure at the lamp terminals is kept constant under the extreme variations of load—thus accomplishing the feat of maintaining automatically a constant pressure on lamps with avarying load, varying speed, and varying "drop" in the line.

The Lacombe Storage Battery Decision.

Brief reference was made in our last issue to the decision rendered by Judge Lacombe in the U. S. Circuit Court, in the suit of the Electrical Accumulator Company vs. the New York & Harlem Railroad Company, on the motion for preliminary injunction. We now give the text in full:

"The question whether or not the battery plates used by the defendants are infringments of the first claim of complainant's (Faure) patent, as it stands after filing of the disclaimer, is to be determined in view of the construction given to that patent by Judge Coxe in the action brought by the complainant against the Julien Electric Company. Under that construction what Faure discovered was the application of the active layer "to the supports (electrodes, plates or grids) in the form of a paste, paint or cement, prior to their immersion in the battery fluid." After hearing the testimony as to the experiments of Brush, and the other proofs as to the prior state of the art, which are again presented on the present motion, Judge Coxe found that the invention was one of more than usual merit, and allowed plaintiff to file a disclaimer, which should save him what he discovered.

Defendant's plates have been made in either of three ways:

First.—By the use of an active material containing over ten per cent. of fluid. This they concede to be a paste, and assert that they no longer use it.

Second.—By mixing the dry powder with about two and a half per cent. of the fluid, and then applying the mixture to the plates or *grids* under hydraulic pressure. The mixture before application does not present the appearance of an ordinary paste, but when it is subjected to high pressure and the particles of the powder and of the fluid are thus extended or brought into closer contact, there ensues either molecular or chemical action which produces what is known as *setting*—the particles of the mixture adhering to each other and cohering to the grid. To the production of this action the fluid is apparently an indispensable agent; no other satisfactory reason for its use is shown.

Whether or not a mixture of dry powder with 2½ per cent. of fluid is a paste while in the mixing tub, it seems to be a true paste at the moment of application; its component parts are substances by whose combination a paste may be formed and such mixture acts as a paste does.

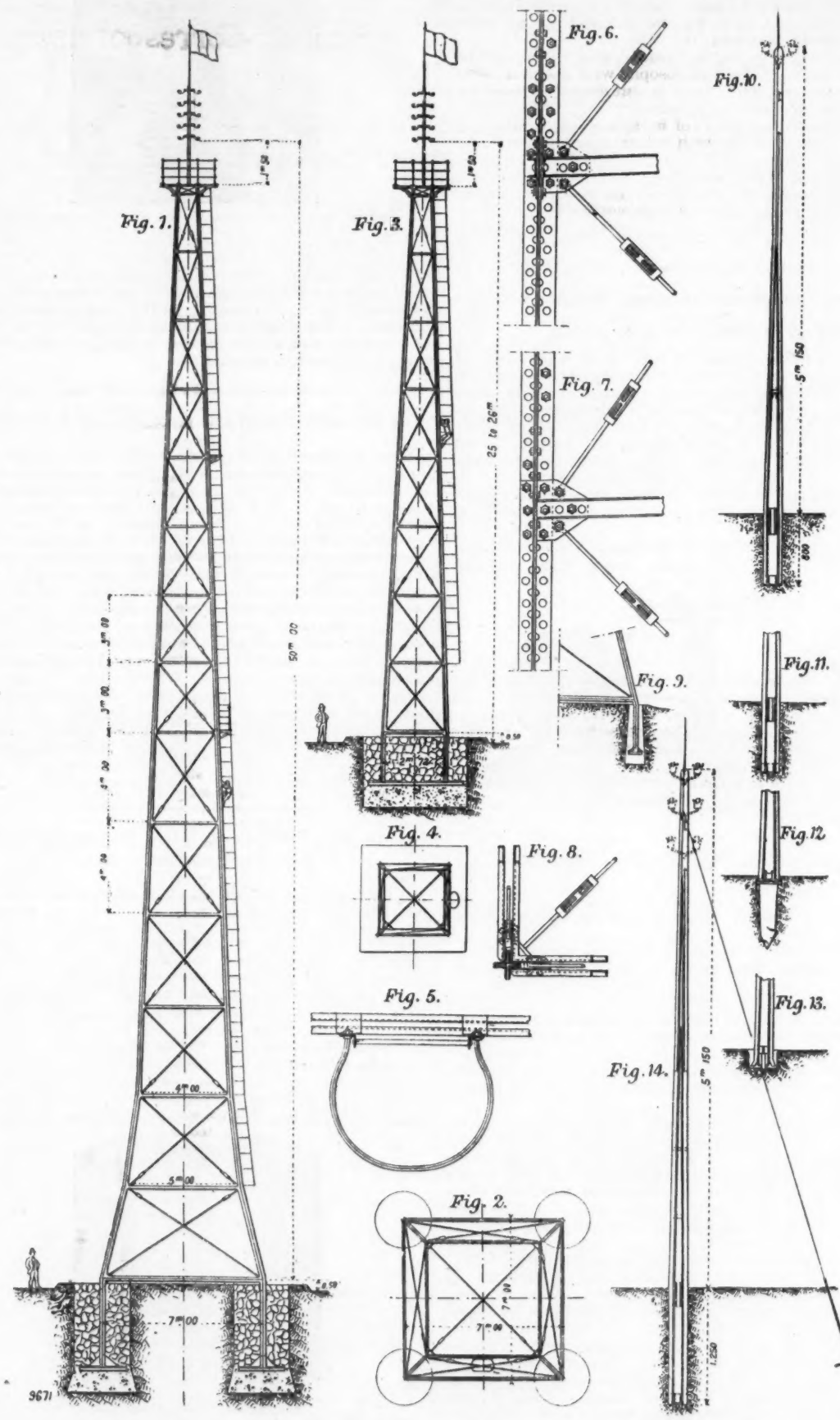
Third: Defendants also force an absolutely dry powder into the interstices of the grid by hydraulic pressure. While the particles of the powder, thus compacted together, are still in place, the grid is moistened with the fluid, either by brushing it over or by applying it to a carpet saturated with the fluid, first one side and then the other being laid for a moment upon the carpet. Sometimes it is also dipped momentarily in a bath of the fluid. The result of these processes (or either of them) is a saturation of the powder; the percentage of fluid in the mixture thus formed is not stated, but it is probably considerably higher than the 2½ per cent. of the second mixture. The mixture thus formed on the grid hardens in a few seconds, apparently going through the same process of *setting* as when mixed in the other methods. The defendants claim that this last process is the same as that used by Brush in the experiments proved in the former case, and that, therefore, it is still open to them despite the affirmance of the first claim of Faure, as modified by the disclaimer. They contend that all Faure did, which Brush did not, was to mix his paste before he applied it to the plate at all. This, however, seems too narrow a construction of Judge Coxe's opinion. If that is all that Faure invented, it is difficult to see in what respect his discovery merited the encomiums passed upon it in the opinion. What Brush did was to immerse a plate coated with dry material not only into fluid, but into the very fluid in which it was forthwith and without removal therefrom put to use as a battery plate. If such immersion of Brush's dry material in the battery fluid did not form a paste because the electric action to which it was subjected prevented its setting (which is what complainant claims), Brush's experiments did not anticipate Faure, who did discover the use of paste. If such immersion of Brush's dry material did form a paste it was formed after, and not before, the immersion of the plate in the battery fluid. Complainant's patent, however, covers any case where the form in which the layer of active material is applied is that of a paint, paste or cement, the application of such paste, paint or cement being completed so as to leave the plates ready for use "prior to their immersion in the battery fluid." Whether the paste is compounded in the mixing tub or on the surface of the grid seems immaterial, if the paste, etc., is, in fact, formed and that process completed before immersion for battery purposes.

The Brush experiments, however, would no doubt cover the defendants' *fourth* method as described by their witnesses, viz., where a perfectly dry powder is compacted upon the grid by a hydraulic pressure, and no fluid is added until the plate goes into use in the battery.—Order accordingly.

Telegraph Material at the Paris Exposition.

In a recent issue we illustrated the telephone pavilion at the Paris Exposition, which was erected by the Société Générale des Téléphones. Besides the exhibit of the latter company, the building contains that of Lazare Weiller & Co., the well-known manufacturers of silicious bronze wire for telegraph, telephone and electric light and power conductors. In addition to their exhibit of line conductors, this firm also shows some of its work in kindred departments, including telephone and telegraph posts, brackets and general fittings; a number of examples are shown at the exhibition, together with a system which figures as the joint invention of MM. Lazare Weiller and the Fives-Lille Company. The telegraph posts made upon this plan consist of four steel angles connected near the top and braced together throughout their length in such a manner as to give them a form of equal resistance; they are made either in one length or divided into sections, according to convenience, the sections being connected very simply by means of fish-plates. The diagrams show the arrangement very clearly, and also how the base of the post can be adapted to the nature of the ground in which it is to be fixed. Fig. 10 is a post of a normal type; the base is formed of a cast-iron sleeve, to which uprights are riveted, the open form given to the base allowing the earth to be packed within the post in order to increase its stability. Fig. 12 shows the type in which the post can be secured to the ground without any excavation; for this purpose it is provided with a screw at the foot. Figs. 9 and 13 show the method adopted for posts that have to be fixed into rock, in which four holes have to be driven corresponding to the four uprights of the post. These are afterward fixed in with cement. Fig. 14 shows a very light type of post, which is held in place by stay rods.

A line of twelve telegraph posts illustrating the foregoing types, and 22 feet high, has been placed in the Exhibition to connect the Agricultural Galleries on the Quai d'Orsay with the Machinery Hall. This line, which follows the Avenue Bosquet, is employed for the electrical transmission of power. The insulators are of the Johnson and Philips type. These steel posts can be adapted to all heights with but comparatively small modifications in their construction. They can, therefore, be employed as signal towers for marine or other purposes, and are especially adapted for supporting wires across very wide spans. Figs. 1 to 8, for which and the other figures we are indebted to *Engineering*, represent two such columns, 85 feet and 170 feet in height. From these sketches, which clearly illustrate the details, it will be seen that the work of erection is very simple, while fixing the wires, inspecting and repairing the column, etc., can be done with greatest ease by means of the ladder that makes every part of the structure accessible.



TELEGRAPH LINE CONSTRUCTION AT THE PARIS EXPOSITION.

The Nature and Operation of Gravity.*

BY HENRY RAYMOND ROGERS, M. D.

Science never yet has furnished a satisfactory explanation, either of the actual nature or the mode of development of this, the master force. Newton, Faraday, and other interpreters of its phenomena, hitherto have failed to find sufficient grounds upon which to base a rational and satisfactory theory. But new light is chasing away the obscurity which has ever enveloped this subject, and to-day even, thanks to recent and most wonderful discoveries and inventions, we are furnished with a sufficiency of clear and exact data for the solution of this great problem.

*Abstract of paper read before the Chautauqua Society of History and Natural Science.

It is a fundamental law of electrical action that all bodies susceptible to electrical excitation become centres of attraction through the operation of the electrical circuit. A body of soft iron is thus made magnetic and retains its power of attraction during its continuance in the circuit. So the sun and earth, being constituents in our great cosmical circuit, both they, and all things which they contain, thus become vitalized with the power which we call gravitation. Gravity is, therefore, an electrical phenomenon.

The great Faraday was fully impressed with the idea of a relationship between gravity and electricity, and for many years endeavored to demonstrate the same, but was unsuccessful. In view of his disappointment he once wrote, "Here end my trials for the present. The results are negative; they do not shake my strong feeling of the existence of a relationship between gravity and electricity." He further says: "The discovery of a relationship between gravity and electricity would have a bearing in importance beyond all conception in elucidating not only the facts connected with these subjects, but also others of a high importance; there being scarcely a limit to the subjects which would be illuminated by it." Thus Faraday, the highest authority in the field of physical philosophy who has ever lived, was fully impressed with the idea that gravity is purely an electrical phenomenon, and undoubtedly he would have demonstrated the correctness of his speculation had he then possessed the data with which we are now so abundantly supplied.

Newton also regarded gravity as due to "some higher," and then still unknown, power, and his teachings point to electricity as the agent he was endeavoring to seek out.

New Storage Battery for Tramway Work.

The Société l'Electrique, which has been operating storage cars in Brussels, has recently brought out a novel form of battery for that kind of work. The battery consists of hollow cones of lead 30 centimetres in diameter, 20 centimetres high and 3 millimetres thick. The external surface of each cone carries a number of projections, which serve the double purpose of supporting the active material and of keeping the cones apart. The internal surfaces are covered with litharge and the external surfaces with minium, and thus each cone plays the double *rôle* of positive and negative plate. The cones are mounted one inside another, and the spaces between them filled with sulphuric acid, the projections forming the contacts. A high output for weight is claimed for this battery.

The Manufacture of the Alloys of Aluminium in the Electric Furnace.*

BY J. H. DAGGER.

Deville's method, modified in detail, is still the chief of the chemical processes for the production of aluminium, and is dependent upon the cost of metallic sodium. The greatest value of aluminium is, however, in its alloys, and the successful application of the intense heat of the electric arc to their production on a commercial scale marks a departure in electro-metallurgy of which we cannot over-estimate the importance, rendering it possible to produce rich alloys of this metal at half the cost of any other method, and so widening the field of their application to an extent hitherto unknown. At the works of the Cowles Company, Lockport, N. Y., U. S. A., there are in operation fourteen furnaces, the electricity for which is generated by three dynamos, capable of supplying a current of 3,000 to 3,200 ampères, and an E. M F. of 55 to 60 volts. These furnaces can produce 2,500 pounds of aluminium bronze (10 per cent.), and 1,800 pounds of ferro-aluminium (10 per cent.), or a total yield of 430 pounds of contained aluminium per 24 hours. The English works of the company at Milton, Staffordshire, contain twelve furnaces, with a 500 h. p. dynamo, built by Messrs. Crompton & Co. It furnishes a current of 5,000 to 6,000 ampères, with an E. M. F. of 50 to 60 volts. The production of these works is 2,300 pounds aluminium bronze (10 per cent.), and 1,800 pounds ferro-aluminium (10 per cent.) per 24 hours, or 410 pounds of contained aluminium. The furnaces are rectangular in form, and are of firebrick; into each end is built a cast-iron tube, through which the carbon electrodes enter the furnace; each electrode consists of a bundle of nine carbons, each 2¼ inches diameter, attached to a head of cast iron for a ferro-aluminium furnace, and of cast copper for aluminium bronze or alloys containing copper. This head is secured to copper rods, or "leads," which can be readily connected with, or disconnected from, the flexible cables supplying the current. Each cable is secured to slides traveling on an omnibus bar of copper overhead, and so can be brought into position opposite the furnaces to be used. The electrodes are arranged so that it is possible, by means of a handle and screw, to advance or withdraw them from each other in the furnace.

Lining the furnace is the first operation; the bottom of the trough is covered with a layer of prepared charcoal, the electrodes are arranged in the furnace, and a "former," a sheet-iron box without top or bottom, each end being arched to fit over the electrodes, is inserted; charcoal is then rammed into the space between it and the fire-brick walls. This done, the charge of ore, mixed with coarse charcoal and the metal to be alloyed with the aluminium, in form of turnings or granules, is placed inside the iron box, after which this is carefully withdrawn; the space between the electrodes is bridged by some broken pieces of carbon, the charge is covered with coarse charcoal, and the furnace closed by a heavy cast-iron cover having a hole in the centre for the escape of gases evolved during the reaction; the cover is luted so as to prevent the entrance of air. The commencing current is about 3,000 ampères, and is gradually increased to 5,000 ampères; a "run" occupies about 1½ hours. The furnace is allowed to cool; the next, ready charged, is connected with the cables, so that the process is a continuous one, the furnaces being successively charged and connected. The crude metal from the furnace is then re-melted in an ordinary reverberating furnace, a sample being taken from each run and assayed for aluminium.

The most valuable of the alloys are those with copper. Aluminium bronze has great tensile strength. A bar containing 11 per cent. aluminium made by the electric furnace, and tested by the Leeds Forge Company, Limited, gave a tensile strain of 57.27 tons, or 128,400 lbs. to the square inch. One, containing 7.5 per cent. aluminium, tested by Prof. Unwin, broke under 36.78 tons = 89,743 lbs. to the square inch. In resistance to compression this alloy equals the best steel; its transverse strength, or rigidity, is about 40 times greater than ordinary brass. Its elastic limit is higher than that of mild steel, and it can be worked at a bright red heat as easily as wrought iron. Its mechanical and physical properties render it useful for every variety of metal work, its high price only having hitherto restricted its use. Its enormous strength and anti-corrodible qualities recommend it as valuable above any other alloy for propeller blades, stern and rudder frames, and for hydraulic and engineering work generally. Above 11 per cent. the alloy becomes brittle, and at 20 per cent. can be powdered readily in a mortar. Another alloy made in the electric furnace is silicon bronze, which, owing to its great strength and tenacity, its resistance to corrosion, combined with high electrical conductivity, is, perhaps, the best metal extant for elctric light, telephone and telegraph wires.

*Abstract of a paper read before the British Association at Newcastle meeting.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
167-177 TIMES BUILDING, NEW YORK, NOV. 2, 1889.

The Elektron Manufacturing Company suffered last week by fire in their Brooklyn factory, but they will go ahead as usual, and there will be no delay in filling orders for their popular Perret motors, etc.

J. S. Hall, 40 Cortlandt Street, New York., of oil cup fame, shipped 3,000 of all his various styles of cups to Erie, Pa., Oct. 31. Mr. Hall's cups are made for dynamos, high-speed engines, etc. All the largest electric light companies are using these oilers. He has lately been adding numerous engineers' specialties to his stock, some of which are his new steam whistle, which gives a musical sound of a pleasant nature, oil filters and tanks, injectors, water-gauge reflectors, and flue cleaners.

Mr. Wm. Marshall, 2 and 4 University Building, cor. Waverley and University Places, is a busy man nowadays, making up his new multiple switch-board for condensers. He has just completed one for Columbia College and another for the Brush Company, while he has many unfilled orders on hand for similar work. I had the pleasure last week of examining this apparatus, which is of the finest workmanship throughout. Mr. Marshall is the only manufacturer of condensers in this country.

An Electric Time Company Sold Out.—John B. Skehan recovered a judgment of $6,922.92 against the Electric Time Company, whose offices are at 60 Broadway, and factory at 45 Cortlandt street, for moneys loaned. To satisfy this judgment the stock and fixtures of the company were disposed of this week at Sheriff's sale and bought in by one of the stockholders for $607. It is stated that the company is to be reorganized on a paying basis, the success of the system of electric regulators having been fully demonstrated.

Wheeler & Crocker Motors.—I stopped in last week to see Messrs. Crocker & Wheeler, 322-324 Seventh avenue, New York, both men of large experience in motor construction, and was shown over their large works, where they are building motors from ⅛ horse power up to any size desired. They have just completed a large order for small motors of their latest design, recently described in THE ELECTRICAL WORLD, which are well worthy of note. They were also completing a new 3 h. p. motor for special application. They have just finished a combined electric motor and pump of very simple and novel construction, which can be made cheaply. They are equipped with all the newest tools and machinery for manufacturing, and all their motors and pumps will be made on the interchangeable plan.

Fenn & Bramar, electrical engineers and contractors, who handle all kinds of construction and wiring work, have been located at 36 Cortlandt street for some time. Mr. W. G. Fenn was with J. H. Bunnell & Co. as their engineer, taking charge of all the outside electrical construction for some six years. His ability is well known in electrical circles. This firm lately completed a big wiring job for Herman Behr, the noted sandpaper manufacturer, at his beautiful home, on Pierpont and Henry streets, Brooklyn. The current is to be furnished from the new Edison station. Mr. C. J. Field, the engineer and manager, is said to have recommended their work, and is willing to let them do all they can undertake. This residence was also fitted out with all the latest household electrical specialties. The firm also fitted out the large National Storage Warehouse with complete fire-alarm apparatus. Eighteen call boxes connect the engineers' rooms, in which are placed large electro-mechanical gongs to notify the engineers in case of fire so that they could immediately start the fire pumps connected with all the warehouses by mains. The firm are also doing a large amount of construction work in New York, New Jersey and Connecticut.

The Empire City Electric Company, 15 Dey street, New York, are busily engaged preparing 25,000 of their new iron box bells to fill numerous orders, one of which was for 3,500. Their new bell has many novel and valuable features, among others a double contact arrangement with jam nuts, all the adjustments being perfectly protected by the cover. The whole bell is put together with a screw driver, and, once adjusted, will always remain so. They have lately imported 40 tons of sal ammoniac from the Continent for battery use. Their new porcelain arc light switch or cut-out is claimed to be one of the most novel and best in the market; it offers no opportunity for arcing, as it makes before it breaks, and *vice versa*. It is completely inclosed in an iron case, with a glass cover, no wood being used in its construction. Porcelain insulating sections are used on either end with double contacts. A full line of electric light, telegraph and telephone cross-arms, pins, brackets, etc., are always carried in stock by the company, which are manufactured at their factory in Adrian, Mich. They also make reels, spools, molding, etc., in car-load lots. Twenty-two car loads of poles were sold last month by the company, and they supplied all the poles for the East New York & Jamaica Railroad, the Tarrytown, N. Y., & Clinton, N. J., electric light plants. Three hundred and fifty 30 to 35 feet poles went to the Auburn, N. Y., Electric Light Company. They are doing well in incandescent lamps, and also handle a very fine brand of line wire. Their No. 6, for example, weighs less per mile than underwriters', and is a compound insulation double braided and very pliable, and they are ready to guarantee every foot of it. The large volume of business that this company has on hand has necessitated their putting on a double force of men and supplying their factory with a 500-light incandescent plant for night work. The business of their Dey street salesroom has so increased in variety of supplies and instruments that they feel the necessity of more room. They are using three lofts and three basements for store rooms, repair work, and the manufacture of the Empire City battery.

W. T. H.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 8, Cook Building, cor. Franklin and Congress Sts.
BOSTON, Nov. 2, 1889.

Greenfield, Mass., is agitating for an electric railroad from Greenfield to Turners Falls, and a petition will in all probability be presented to the next Legislature.

Beverly, Mass.—The Beverly and Danvers storage battery road, using the system of the Union Electric Car Company, of Boston, has been opened to the public and the cars will now run regularly.

Frank Ridlon & Co. have recently sold a 30-light Brush dynamo, two 50-light American dynamos, three 10-light and one 20-light New England Weston dynamos, and a 4 h. p. Baxter motor. Verily, the second-hand business boometh!

Newton, Mass.—The new McIntosh & Seymour compound condensing engine, ordered by the Newton and Watertown Gas Light Company, arrived at their station during the past week, and is now being set in place. The boilers are also about completed, and in a short time the apparatus will be moved from the old station to the new.

Mr. H. C. Duncan, of the American Waltham Watch Company, has just returned from the St. Louis Exposition, where he had great success in the sale of the non-magnetic watch. Mr. Duncan does not get much time to devote to his many Boston friends, as he is now busily engaged getting ready for a very long trip through the West, as far as the Pacific Slope, and will leave us again in a few days.

J. A. Grant & Co., of this city, have secured the contract for the installation of the power plant for the Albany (N. Y.) Street Railway Company, and the work is now in progress. The present station is arranged for six special railway engines, of 300 h. p. each, and sectional boilers of the Babcock & Wilcox type will be used for supplying the steam. The engines are all to be of the compound condensing type manufactured by McIntosh, Seymour & Co.

Newport, R. I.—The Newport Street Railway Company are having a lively time contesting numerous suits which have been brought against them by property holders on the route of the electric cars, who claim that their property has been very much depreciated. The cases will come before the Court of Common Pleas next month, and the outcome will be looked forward to with interest by electric railroad men. It is not supposed that the claims can be maintained.

Wainwright Heaters.—The Wainwright Manufacturing Company, of Massachusetts, have sold the following heaters within the past week: Canton Electric Light Co., Canton, Mass., 150 h. p. heater; Canada Electric Co., Amherst, N. S., 100 h. p. heater; Davenport Machine Company, Davenport, Iowa, 100 h. p. heater for an electric railway plant, and a 300 h. p. heater to a Chicago electric light plant. As these heaters become more generally known, they meet with universal favor, owing to the exceptionally good results they give, and engineers in charge of plants have all a good word to say for them.

The Edison Electric Illuminating Company, of Boston, have recently secured the contract for lighting the Boston Theatre, and will commence by installing 600 lights at present, though it is expected in time that this number may be trebled. These lights will be used exclusively in the auditorium and for the footlights. The switchboard will be made large enough to provide for the whole house. The Boston Theatre is one of the largest theatres in the country, and possesses the largest stage of any in the United States. The fixtures will be unique. The Edison Company is at present increasing the feeder on Tremont Street, Edison tubes of 500,000 circular mils being laid in place of the Callender feeders of 250,000 circular mils, which are being torn up, having served their day and generation. In the spring considerable increase in the underground system will be made all over the city.

A New Idea in Conduits.—A patent has been allowed to Mr. J. Tennant Lee, the inventor of the molded mica insulator, for a new form of electrical conduit. Mr. Lee's chief aim was to get a conduit which would prevent any moisture and gas from getting at the wires inside the ducts. He accomplishes this by the simple means of filling each of the ducts with flaked mica which thoroughly fills the whole space, but which is yet so yielding that a wire can easily be drawn through. Mr. Lee intends to use indurated fibre pipe, and leading-in wires can be inserted when the pipe is laid down. The insulation of the wires consists only of one dry cotton braiding with no paraffin or insulating compound, as Mr. Lee claims that when the wire is in the conduit and thoroughly embedded in the flaked mica no moisture can possibly attack the insulation, and as long as the cotton can be kept dry the insulation will remain perfect. A trial mile of this novel system will be laid down and the experiment will be looked forward to with interest.

Praying for Rain.—Another instrument required for the complete installation of some of the plants in Maine is a *barometer*. Lately managers of many of the plants in the grand, picturesque State of Maine have been driven daily to consult that useful instrument, in the hopes that they could see signs of an approaching rainstorm. Praying for rain is a new vocation for electric light men, and yet so unusually dry have been the rivers in Maine lately that the numerous plants run by water power have been taxed to know where the power was to come from. In Maine there are some thirteen well-known stations run by water power; two at Bangor, one at Skowhegan, one at Augusta, one at Waterville, one at Lewiston, one at Saccarappa, two at Auburn, one at Brunswick, one at Fairfield, one at Dexter and one at Ellsworth; and Mr. Levi Coffren is my authority for stating that the managers of one and all have been in daily communication with the clerk of the weather to furnish them with such weather as would conform to the successful operation of their electric light stations.

Simplex Electrical Company.—Dr. Mason never goes from home without returning with his hands full of orders, and the recent trip out West, from which he has just returned, is no exception to the rule. Electric light men still call for Simplex wire, and Simplex wire they must have. At the same time, Dr. Mason is highly alive to the fact that for certain purposes, where very high insulation is absolutely necessary, a superior grade of wire becomes needful, and a few months ago he began, in a limited way, to cover wire with a rubber compound. This rubber compound, unlike most other rubber insulations, contains no foreign gums, but is composed simply of pure caoutchouc and a fine powdered substance. This gives to the insulation great solidity, while at the same time it preserves its elasticity. On setting fire to this insulation, which, by the way, is not easily done, nothing drops away from the wire, the rubber simply burning out and leaving the wire covered by the powdered material originally introduced. Dr. Mason has had such a large call for this rubber-covered wire that he has ordered a complete set of rubber-working machinery, and hopes in a month or two to be able to supply his customers with as much as they want.

A. C. S.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
39 Mallers Building, Chicago, Oct. 30, 1889.

The San Francisco Electric Club is prospering nicely, the membership steadily increasing.

East Portland, Ore.—The Waverley & Woodstock road is to have a Thomson-Houston equipment.

The North Evanston Village trus tees have been petitioned to electrically light that suburb of Chicago.

Mr. Myron A. Knapp returned to Chicago this week from an extended trip to the Pacific Slope, where he secured some remarkably good sized orders.

Mr. C. K. Giles, of Chicago, is mailing to his many friends a handsome souvenir in the form of a book of poems bound within covers of celluloid neatly engraved.

The Carlinville, Ill., Street Railway Company has been formed, to build an electric road, by F. L. Bates, B. M. Bates and A. L. Given, with a capital stock of $25,000.

Mr. F. G. Stone, of the Aluminum, Brass & Bronze Company, New York, and formerly with the Ansonia Brass & Copper Company, is calling on the trade in this section.

San Jose, Cal.—The Electric Improvement Company of San Jose has been formed by C. W. McAfee, T. C. Van Ness, A. J. Bowie and others, with a capital stock of $100,000.

The Hutchinson, Kan., City Council have granted a franchise to a new company to build and operate a system of electric street railways, same to be in operation within six months.

H. Fischer & Co., of Sacramento, Cal., have ordered the installation of a battery of accumulator cells sufficient in capacity to furnish current for sixty 16-c. p. lamps during twenty-four hours.

Mr. Ernst Hoefer, of Chicago, made a flying business trip to New York this week, and effected some excellent arrangements with several large houses with a view of representing them in the west.

Mr. D. R. Russell, of the Parker-Russell Mining and Manufacturing Company, St. Louis, has been introducing Mr. C. W. Hazeltine to their various customers in this section during the week.

Mr. J. J. Gates, of the Perkins Electric Lamp Company, Hartford, Conn., who has been attending to matters of importance in Chicago during the week, reports that their business prospects are unusually bright.

The Citizens' Street Railway Company, of Springfield, Mo., have asked the common council for permission to substitute electricity for horses, and to extend the life of the franchise to thirty-five years.

Seattle, Wash.—The Green Lake Electric Railway Company, has been formed with a capital stock of $150,000, by E. C. Kilbourne V. H. Smith, C. P. Stone, O. J. Carr, D. T. Denny, L. H. Griffith, J. Leddy and W. D. Wood.

Mr. Huntington Lee, of the Eureka Electric Company, New York, is visiting friends in Chicago, after a pleasant stay in St. Louis, where he exhibited the Loomis system of indcandescent lighting at the Exposition.

The Rico Electric Light and Power Company has been organized and incorporated at Denver, Colo., by David Strickhunier, G. F. Barlow, H. R. Woodale, H. H. Corbin, and C. W. Corbin, with a capital stock of $10,000.

Mr. Stetson Leach, manager of the River and Rail Electric Company, Denver, Col., has been purchasing a quantity of supplies in Chicago during the past week for his company, and reports business prospects unusually good.

The Electric Light and Coke Company, at Belleville, Ill., to supply coal and furnish electric light and power, has been incorporated. Capital stock, $70,000. Incorporators, John Brosius, G. W. Knobeloch and John E. Thomas.

Mr. Samuel H. Taylor, of San Francisco, has taken the contract for installing the Thomson-Houston electric railway system in San José. It is expected that the overhead wires will be strung on iron supports placed in the centre of the street.

G. E. Fish, Electrician of the Chicago Arc Light and Power Company, states that they are using the Rudd grounding device recently illustrated in THE ELECTRICAL WORLD for testing the circuits while the plant is in full operation, and are well satisfied with it.

The American Electrical Works, of Providence, R. I., have issued to their friends a tasteful Japanese circular, accompanying a Japanese coin, which it is desired each fortunate recipient shall carry as a pocket piece. Probably, in every case, the coin will be thus used.

Mr. J. W. Chipman, of Indianapolis, Ind., has successfully carried through three or four recent electrical deals that proved very profitable to him. While agent of the old American Electric Manufacturing Company he was quite successful in placing the American system.

The Northeast Electric Railway Company, Kansas City, will use two Armington & Sims engines, which they have purchased, including entire steam plant, from the Pond Engineering Company. The Pond Company also install the steam plant for the electric railway in Laredo, Texas.

Mr. W. S. Andrews, of the Leonard & Izard Company, returned from Minneapolis, and left for New York this week. His friends are glad to see Mr. Andrews about again, and, while sorry to have him leave this field, know that he will be appreciated and cordially welcomed in his new field of labor.

The Sprague Electric Equipment Company, of Chicago, have issued a neat catalogue of supplies used in the construction and operation of electric railway lines. This company has received an unusual number of inquiries regarding the cost of installing their system since the Minneapolis convention.

The Elgin, Ill., Payne Street Car Line has formally passed into the hands of the Elgin City Railway Company, of which George P. Lord is president. The consideration is about $40,000, three-quarters being in stock of the new company. Next spring an electric plant will be put in and nine miles of track laid.

Porta Costa, Cal.—The Pacific Electric Storage Company have sold a plant of 28 cells to the Southern Pacific Railroad Company, to run a motor for raising and lowering the apron at a steamer slip at Porta Costa. The results already obtained are reported in the *Pacific Lumberman* to be very satisfactory.

The Des Moines City Council visited Omaha and Council Bluffs last week, inspecting the electric railways there in operation. They report most favorably regarding the superiority of the electric system over the cable, and state that they could not learn of a single complaint having been made against the system.

Mr. Andrew Shillinglaw, the electrician of Armour & Co.'s large plants in Chicago and Omaha, met with a sad bereavement in the loss of his wife last Sunday. Mr. Shillinglaw was waiting at the railway station to meet his wife and accompany her to Colorado, when a telegram was received notifying him of her sudden death.

The Sioux City Street Railway Company signed a contract with the Chicago office of the Sprague Electric Railway and Motor Company on Oct. 7. The following day the greater portion of the supply material was shipped, and on Oct. 9 the linemen were at work on the ground—a fair sample of Western push and enterprise.

Mr. George Westinghouse, Jr., is the principal stockholder in a fuel gas company that has stated that an abundant supply of artificial fuel gas will soon be produced at less cost than the natural product can be piped, thus enabling all the manufacturing industries around Pittsburgh to continue work irrespective of the flow of natural gas.

The Pond Engineering Company have furnished the American Electric Light Company, of Kansas City, with a 50-h. p. Armington & Sims engine, and the Empire Cordage Company, of Champaign, Ill., with a 15-h. p. Gardner vertical engine for driving their isolated Edison plant. They will furnish and erect two 150-h. p. boilers, complete, with Pond Engineering Company setting for the St. Louis Smelting and Refining Works.

The Short Electric Railway Company, of Cleveland, have issued an illustrated catalogue descriptive of the Short system of electric propulsion. The heavy paper and neat, bold type and handsome engravings of the various parts of their apparatus, as well as photo-engravings showing portions of various roads now equipped and in full operation, make the work worthy of a place on the library table of every electrician desirous of being well informed on the merits of this system.

The Rockford Electric Street Railway Company, Rockford, Ill., held its first meeting Oct. 24, and the following were elected directors: Levi Rhodes, H. W. Price, Anthony Haines, R. N. Bayliss and his brother, of Des Moines; W. E. Andrews and E. W. Waldron, of Elgin. The officers elected were: R. N. Bayliss, President; Levi Rhodes, Vice-President; Fred. Haines, Secretary and Superintendent, and W. H. McCutchan, Treasurer. The electric line will be put in at once.

Postal Telegraph Extensions.—The directors of the Postal Telegraph Company are seriously considering the extension of their lines throughout the West. L. D. Parker, the general superintendent, and C. M. Baker, superintendent of construction, are here making an investigation with that end in view. It is the purpose of the company to run lines to Wichita and Topeka, Kan., Denver and Leadville, Colo., connecting with Texas via Wichita, and ultimately with the Pacific Coast via Denver.

The Dubuque, Ia., City Council have granted charters to four new electric light companies and one additional street car company, the latter to operate its cars by electrciity. Much opposition was waged against this result by the present antiquated street car company, but the wishes of the people were finally gratified by the council. This gives Dubuque three street car companies and five electric light companies, and is the open door through which it is hoped the city will march on to greater prosperity.

Mr. and Mrs. F. W. Cushing gave a delightful reception at their home in Highland Park recently. The house was elaborately trimmed with plants and flowers, roses and carnations being used in profusion. Mrs. Cushing was assisted in receiving by Mrs. N. E. Swartwout, both of them wearing charming evening toilets. An elaborate supper was served during the evening by Kinley, while Valesi's mandolin orchestra furnished the music. About 150 guests were present, and all had a most enjoyable time.

Obituary: Mr. E. J. King, one of the most prominent citizens of Jacksonville, Ill., died at his home on Monday morning of typhoid fever. Mr. King was the secretary, treasurer and superintendent of the Jacksonville Gas Light and Coke Company, operating the Thomson-Houston system, and was the president of the Western Gas Association. He leaves a wife and two children, who have the full sympathy of all the fraternity in their great loss, that was deepened and made all the harder to bear by the death, a few hours later, of Mr. King's brother-in-law, Dr. Charles Easter, who had been in constant attendance on Mr. King until a few days ago, when he, too, was stricken down.

The Pacific Electrical Storage Company, of San Francisco, recently installed a battery of accumulator cells in the railway depot at Benicia, Cal., to supply current to operate an electric motor employed in raising and lowering the great apron over which pass the trains from the ferry-boats to the main track. The cells were recharged each evening by the local lighting station and guaranteed to do all the work required during the 24 hours. A few days since an accident compelled the lighting company to shut down for two days and a half, yet the single charging of the cells operated the motor during the entire period without exhausting the cells, and afforded so much satisfaction to the railway company that they have ordered an installation for the same work at Port Costa, on the opposite side of the straits of Carquinez, but as there is no electric plant at Port Costa the cells will have to be ferried over to Benicia each evening for recharging.

The Chicago Electric Club.—In accepting the resignation of Mr. Silas A. Barton as its president, the Chicago Electric Club has lost the services of an official, the memory of whom will always be fresh around the present quarters, for Mr. Barton has ably redeemed his promise to put the club on a solid basis if re-elected, and the praises accorded and the regrets tendered were heartfelt, honest and well earned. Mr. Barton's services were duly recognized last week at a special meeting of the club, when a series of resolutions expressing the regret of the club at his departure were warmly worded and endorsed. After the meeting, over 100 members and guests, including Mayor Cregier, partook of a supper prepared by Kinsley. It is understood that Mr. Barton will find abundant work awaiting him at the Boston offices of the Thomson-Houston Electric Company, where among his duties will be those of purchasing agent for that vast manufacturing organization.

Mr. Arthur S. Huey, a prominent electrical engineer of Minneapolis, Minn., in directing the wiring of modern fire-proof structures, has often observed the pressing need of some suitable compound the employment of which would enable him to permanently affix the wires to the unfinished walls or ceiling, whether of wood, iron, stone or plaster, especially where cleats could not be used. And so clearly does he appreciate the value of such a compound to the electrical profession that he will gladly contribute $25 toward a prize to be given to any one who shall devise a compound "paint, paste or cement" of suitable composition to be a non-conductor of electricity and yet retain a soft consistency for just a sufficient length of time to permit the wires to be properly placed and strongly cemented in position. A composition in powdered form similar in nature to plaster of Paris would answer, provided it did not harden too quickly, as water is often more accessible than heat.

Mr. Alexander Kempt, of Chicago, believes, as do others, that the day is not far distant when the application of electric motors to operate pumps directly connected with the city water mains, and suitably located at street intersections, will entirely do away with the type of fire engines now employed, which come thundering down the street whenever an alarm is sounded. Large central stations could be erected on the outskirts of the city, where the smoke and noise would cause no inconvenience, the generators located therein and connected to the motors by overhead or underground conductors, while the turning in of the alarm of fire at the signal box would operate a switch or other device throwing the motor into circuit, thus raising the water pressure to the highest point by the time the firemen had stretched their hose, thereby often saving valuable time. Mr. Kempt has mentioned other details that can easily be worked out and will aid in simplifying the work of fighting the flaming element.

Business Prospects.—The Sperry Electric Company find themselves cramped for room, owing to the large number of machines now in course of construction, and are considering the advisability of moving into the Springer Block, on Canal street, which is directly in rear of their present quarters. The Electrical Supply Company are so crowded for room that there is no opportunity to carry the stock they desire, while the Central Electric Company contemplate a change of location, though now occupying four floors and basement and an outside warehouse. The Elmer A. Sperry Company have removed from the ill-fated Burton block to the handsome manufacturing block erected by Warren Springer on Canal street. The two fires that destroyed the south half of the Burton block badly crippled Mr. Sperry's facilities for turning out work, but in the new and convenient quarters every order will receive prompt attention. The fire consumed the patterns of the Sperry Electric Mining Machine Company and delayed greatly the shipment of machines; but in the future little or no delay will occur

The American District Telegraph Company, at Minneapolis, is one of the prosperous institutions of that growing city. Over 300 eleven call-boxes and 200 single call-boxes are in service on 150 miles of No. 12 wire, requiring the services of twenty-five regular messengers on the day watch and a less number during the night. In addition, there are forty watch service subscribers, having from three to eight boxes each; while alarms of fire are transmitted on two different circuits directly to the central station and to the engine-house located nearest to the point whence the alarm came, thus saving valuable time. These two latter circuits employ some ten miles of special wire and are known as the fire alarm circuits. The Gamewell system is employed by the city. Mr. J. W. Phinney is the electrician of the company, and to his care in having the circuits at all times in perfect working order much of the success of the company is due. Mr. Phinney also has twenty boxes of the Holmes electric burglar alarm system in his care. J. C Haynes is the president and A. T. Williams the general manager of the company.

The New York Life Insurance Company's million-dollar ten-story fire-proof building in St. Paul is one of the most substantial and elegant office structures in the country, and contains a complete incandescent plant of the Brush system, consisting of two 650-light dynamos coupled to a McIntosh & Seymour high-speed engine; a marble switchboard of improved design. An Ayrton & Perry voltmeter, and two of Queen's ammeters are conveniently arranged for service, and the current is carried from the dynamo to a distributing board in rear of the switchboard. The system of wiring is so arranged that half the number of lights on each floor are on a separate circuit and controlled from the dynamo room, as are also the hall lights, thus insuring at all times a sufficiency of light for ordinary purposes should an accident happen to either one of the circuits. Both circuits can be connected to either dynamo or the reverse. The combination fixtures are of solid and spun brass, and of elegant design, set off with rich cut-glass globes The installation was made under the direction of Mr. Alexander Kempt by Irwin J. Beaumont, of St. Paul, and H. L. Palmer, a graduate of the Cornell class of 1887, who is the engineer now in charge of the building. Mr. Palmer states that the perfect working of the plant has been noted by many contemplating the purchase of an incandescent system, and that the engines have won the admiration of all visitors. F. DE L.

MILWAUKEE, Wis., Oct. 12, 1889.

The Wisconsin Telephone Company have let the contracts for a new fire-proof building three stories high, with a ground measurement of 60 × 24 feet, to be erected immediately in the rear of its present structure. Upon its completion and occupancy the building now in use will be pulled down and a new one erected.

Waukesha, Wis.—At the meeting of the village board last week the subject of a street railway came up, and an ordinance granting a franchise to Messrs. Fitch and Jarvis, of Louisville, was adopted with but one dissenting vote. Electricity is the proposed motive power, and the ordinance provides that the wires shall be placed underground if at any time such demand shall be made by the village.

The Edison Franchise.—The Common Council has finally passed the Edison electric light franchise, and the Mayor's signature is all that is required to make the measure a law. The vote was 33 to 1. The ordinance granting the old street railway companies authority to use the overhead electric system was passed to a third reading, and the ordinance giving the Milwaukee Telegraph Company a franchise similar to those of the Badger and Edison companies was reported favorably by the committee on judiciary. The Badger Illuminating Company was ordered to place electric lights on Wisconsin street from Broadway to Van Buren street.

W.

LOUISVILLE, Ky., Oct. 16, 1889.

The New Union Depot.—The Louisville Electric Light Company have secured the contract for lighting the New Union Depot for a term of five years with arc and incandescent lights.

The Louisville Electric Light Company have now running in connection with their other incandescent lights, two alternating machines of the Westinghouse type, and Mr. Gaylord says he can now furnish a current of any voltage.

A Big Store Plant.—The new building of the Mammoth Clothing Company, which will soon be completed, on the site of their old building, which was burned in the spring, will be thoroughly equipped with all kinds of electrical apparatus, including a complete arc and incandescent light plant, a motor to run the elevator, and electric bells for all departments.

The Gaynor Electric Company, of this city, have secured another large contract at Nashville, Tenn. This time it is for the complete equipment of the South Nashville, and the Nashville and Edgefield Street Railway Companies with the Sprague system. The contract is the largest ever given in the South, and will involve an expenditure of nearly $100,000. Nashville will then be placed among the foremost cities in the country for rapid transit, as the other roads will use electricity as a motive power, before the end of the present year.

W. J. F.

KNOXVILLE, Tenn., Oct. 12, 1889.

Mr. J. C. Duncan.—A change in electric circles here took place Oct. 1. Mr. J. C. Duncan, manager of the Western Union Telegraph Company at this place since July, 1866, has been elected secretary, treasurer and general superintendent of both the Knoxville Electric Light and Power Company (Thomson-Houston sys-

tem) and the Knoxville Schuyler Electric Light Company. Mr. Duncan's ability as an electrician is well known, and he is well fitted for the position. Mr. J. M. Creamer, of Baltimore, late quadman of the Western Union at Richmond, Va., succeeds Mr. Duncan as manager of the Western Union Telegraph Company. Mr. Creamer is well known to the craft, and is a thorough gentleman, with a keen eye to business, and is well fitted to fill the position.

SOUTHERN NOTES.

POCAHONTAS, Va., Oct. 25, 1889.

To Light a Mine.—It is the intention of the Marr Construction Company to light up one of Mr. John Cooper's coal mines, in order to prove the feasibility of lighting coal mines by electricity. Mr. Kingsbury is now at Pocahontas with this object in view.

The Bramwell-Pocahontas Electric Light Plant, located at Mill Creek, W. Va., was successfully started on the evening of Tuesday, Oct. 15, and current supplied to 500 incandescent lamps at Pocahontas, Va., and Mill Creek, Bramwell and Simmons, W. Va. The system is the Westinghouse alternating, and the plant was put in by the Marr Construction Company, through their Baltimore office, Lester L. Kingsbury, Esq., manager. The plant consists of one 80-h. p. boiler, a 60-h. p. Westinghhouse automatic engine and one No. 1 (750 lights) dynamo. The station is located in the wildest part of West Virginia, at an altitude of 2,266 feet. The pole lines, on leaving the station for Bramwell and Pocahontas, run in opposite directions, and in crossing the mountains to reach these places it was necessary to hew a path through dense woods and up almost perpendicular bluffs, inaccessible even to the sure-footed mule. The entire circuit comprises about fifteen miles of copper. Pocahontas is lighted by an incandescent street system, to the great disgust of the hoodlum element, which makes night hideous in these mining towns, especially after a pay. The difficulties of constructing a plant in these mountains can only be appreciated by seeing what obstacles had to be overcome. At the present time the prospects for an increase are very good, as negotiations are pending between the local company and the Norfolk and Western Railroad Company for the lighting of their yards and depots on both sides of the mountain.

ENGLISH NOTES.

[*From Our Own Correspondent*]

LONDON, Wednesday, Oct. 16, 1889.

Two Systems of Storage Battery Distribution.—In spite of the advent of the alternate current transformer, the storage battery still continues to hold its own in this country, and there is afforded at the present moment an excellent opportunity for a comparison between two rival systems of storage battery distribution by the operations of the Chelsea Electric Supply Company at Chelsea, and of the Kensington & Knightsbridge Electric Lighting Company at Kensington. The test will be all the more valuable, since these two districts are not only contiguous, but are both of the same description; namely, wealthy residential quarters. The Chelsea Company, which is fathered by the Brush Electrical Engineering Company, the Electrical Power Storage Company and the Callender's Bitumen Company, has adopted an ingenious, but complex system of distribution, devised by Mr. F. King, the well-known electrician to the "E. P. S." Company. The Kensington & Knightsbridge Company, with which Mr. R. E. Crompton is connected, has adopted that gentleman's method of distribution. The principle of the King system consists in the placing of groups of batteries in sub-stations, each group being divided into two halves. The half-groups are charged in series in succession and are then discharged in parallel on the lamps. The novelty of the system does not, however, lie in this arrangement, which was indeed tried at Colchester in a slightly modified form so far back as 1884, but in the automatic devices employed, with regard to the complexity of which I will endeavor to give your readers a faint idea. We first of all have a gas chamber, which collects the gas evolved from a "master cell." This gas passes into a small gasometer, the size of which is calculated so as to contain just sufficient gas as will be given off by one plate after the cell has been fully charged. The moment it fills the following cycle of operations is made to take place by the successive closing of different local circuits and the consequent actuating of various electromagnets: First a separate resistance is switched into parallel with the half group being charged; this is then switched on to the lamps in parallel with the other half group. The latter is next put in parallel with the resistance on the charging mains, and finally the resistance is withdrawn. When the second half-battery is charged the gasometer simply switches it into parallel with the first half and both halves discharge upon the lamps. A tell-tale wire back to the generating station actuates at this moment a relay at the generating station, which cuts off the steam. To keep the pressure constant, tell-tale wires are run from the batteries to various points on the mains and the variations of current in these actuate double-acting solenoids, by means of which the number of "back E. M. F." cells in series with the discharging battery is varied from 0 to 4. In order to maintain an equal discharge from each half battery a "current balance" is used. This apparatus is made of two coils of large section wound in opposite directions. The whole current from each half-battery passes through one of these. Should one half-battery be giving current at such a rate as to run some 10 per cent. below the other, the coil acts solenoidically, and by appropriate devices the number of "back E. M. F." cells in the circuit of that half-battery is altered. Another minor device is a small relay, which is actuated from the generating station when the engineer is ready to start, and which brings the first half of the batteries into the charging position. Finally we have continuous current transformers which come to the help of the batteries during the hours of heavy discharge, and which are also brought into play by automatic devices. Mr. Crompton's system of distribution is in striking contrast to this mass of complexity. It is essentially a multiple wire system in which batteries are employed to maintain the balance in the different sections, the batteries also serving as a source of current during the light hours. The only regulation necessary is a slight hand regulation. A few cells in each group are arranged in parallel with one another, and when the E. M. F. of the battery falls, they are successively switched into series with the remainder. The system employed by the Kensington & Knightsbridge Company has, therefore, the obvious advantage of simplicity, and is, moreover, somewhat more economical, since a large proportion of the current goes to the lamps direct without undergoing any transformation. There is, however, the disadvantage that the consumer's premises are in direct connection with a high potential circuit, and that the number of sub-stations on one circuit cannot for this reason be indefinitely increased. Up to the present, however, the demand for current has not been such as to necessitate the introduction of sub-stations at Kensington, and the batteries are all at the generating station. It will nevertheless be of great interest to watch the relative success of the two systems of storage battery distribution, and to observe what modifications operations on a practical scale show to be necessary in both the automatic and non-automatic methods.

Death of Dr. Joule and Sir Daniel Gooch.—Two men of widely different calibre, but whose names are both intimately connected with electricity, have passed away this week at a ripe old age. James Prescott Joule died at Sale, near Manchester, on Friday night, after many years of weakness and ill health; and yesterday afternoon Sir Daniel Gooch died at his residence, Clewes Park, after a few days' illness. Joule was born at Salford, Manchester, on Christmas Eve, 1818, so that he has died within a few weeks of his seventy-first birthday. At the age of fifteen he and his brother were sent by their father, a brewer, to study chemistry under the great Dalton. Joule seems at once to have been fired with the spirit of scientific research, and began to experiment with the rudest apparatus. One of his first papers, published at the age of nineteen, was on a new electro-magnetic engine. At his death, nearly one hundred papers of his stood on the Royal Society list. His accurate mind was early offended by the arbitrary and unscientific numbers then used to denote electric currents, and he, therefore, took as *his* unit the quantity of electricity required to decompose nine grains of water. The discovery of the mechanical equivalence of heat, Dr. Joule's chief title to fame, was first announced at the Cork meeting of the British Association in 1843, in a paper on "The Calorific Effects of Magneto-Electricity, and on the Mechanical Value of Heat." In it the following passage occurs: "I have lately found experimentally that heat is evolved by the passage of water through narrow tubes. * * * I obtained one degree of heat per pound of water from a mechanical force capable of raising about 770 pounds to the height of one foot. * * * I shall lose no time in repeating and extending these experiments, being satisfied that the grand agents of nature are, by the Creator's fiat, indestructible, and that, *whatever mechanical force is expended an exact equivalent of heat is always obtained.*" The importance of the discovery of this law to the scientific world it is impossible to overestimate; it has enabled engineers to improve their engines upon strictly scientific lines, and it is an important link in the strong chain of proof that all forms of energy are really manifestations of one force. As promised in the above passage, Dr. Joule lost no time in repeating and extending his experiments; and in 1878 his last published result was that 772.55 foot-pounds were the mechanical equivalent of one pound of water raised from 60 degrees to 61 degrees Fahrenheit. The great scientist lived the most retired of lives, and consequently was hardly known at all to the busy outside world, but it is possible to think that his last days were cheered by the news that the great International Congress at Paris had formally ratified the nomenclature which had long been in vogue in this country, and had decided that the practical unit of work should be called after him. Toward the close of his life gold medals and other marks of appreciation were showered on the retiring "savant." In 1878 Her Majesty, through Lord Beaconsfield, then Prime Minister, conferred upon him a pension of £200 a year, and rarely has a pension been better earned. Sir Daniel Gooch was born in 1816, and at an early age displayed a great taste for mechanics, and after becoming acquainted with George Stephenson, he decided to devote himself to engineering. In 1864 Sir Daniel, then Mr. Gooch, was a director of the Telegraph Construction and Maintenance Company, and it occurred to him that the Great Eastern, in which he had an interest, might be utilized in laying an Atlantic cable. The Great Eastern Steamship Company was formed, and that company, the Telegraph Construction and Maintenance Company and the Atlantic Telegraph Company worked in unison. In 1865 the Great Eastern sailed from England with 5,000 tons of cable aboard. The cable broke in mid-ocean and the vessel returned. However, Mr. Gooch still retained faith in the scheme, and on July 1st, 1866, the Great Eastern again put to sea with another cable on board. A few weeks after, a cablegram was flashed across the Atlantic. On his return to England Mr. Gooch was made a baronet, and he has since then been mainly before the public as chairman of the Great Western Railway Company.

THE TELEGRAPH.

T. M. B. A.—Assessment No. 235 for November for $1 has been made to meet the death claims of G. S. Ladd and W. Mackintosh.

Argentine Republic.—The Republic is willing to guarantee interest on the investment in a cable to be laid from Marseilles to Buenos Ayres. The cost would be about $10,000,000; at least, a company is to be formed with that capital.

How They Manage in Russia.—In Russia the telegraphic system is under government control. One of its rules requires that no female telegraphist shall marry any one not employed as a telegraphic operator, and it also requires that in case of sickness the wife shall be the substitute of the man, and perform double service.

Reprieve by Electricity.—The execution on the 30th of last month of a man for murder in Andalusia, in Spain, twenty-four hours after a reprieve had been actually signed by the Queen and forwarded, has occasioned so much excitement in Spain that the government has drawn up a bill to give to a telegraphic message in such cases the force of a formal written order. In this case the authorities charged with the execution were notified by telegraph that the reprieve had been signed and was then on its way, but they insisted that they were powerless to delay the execution in the absence of the formal documents.

United Telegraph Operators.—The annual entertainment and reception of the United Telegraph Operators of New York and vicinity was held at the New Central Opera House on Thursday last, and was unanimously voted a social success. The great hall was crowded, and, judging by the large attendance, it must have been financially successful as well. The programme for the evening included character songs by Mr. M. J. Dixon, recitations by Miss Lillian A. Thorpe, and a duet, sung by Messrs. Arthur F. Hurd and Mr. J. A. Rennie. Robertson's favorite comedy of "Caste" followed the above, and the rendering was an unusually excellent amateur performance. Special mention must be made of Miss Jessie Wallack, who captivated the audience in her excellent *Polly*. Dancing was next in order, and when daybreak dawned upon the assemblage many were the regrets that the affair was at an end.

Baltimore & Ohio Telegraph Litigation.—Judge Dennis, in the Circuit Court, at Baltimore, on Oct. 16, began the hearing of the bill filed by John H. B. Latrobe and others, representing about $80,000 of the stock of the Western Telegraph Company, of Baltimore City, against the Western Union Telegraph Company, which is the holder of about $90,000 of the stock of the same company. The object of the suit is to obtain a decree declaring that the stockholders of the Western Telegraph Company, of Baltimore City, are entitled to the poles, wires, insulators, etc., of about four hundred miles of the telegraph line extending along the line of the Baltimore & Ohio railroad from Baltimore to Wheeling, West Virginia. The bill asks for the appointment of a receiver. The Western Union claims in its answer that the poles and wires are practically of no value if removed, and that it is under no obligation to the minority stockholders to account to them for the value or use of them.

THE TELEPHONE.

New York City.—The Metropolitan Telephone and Telegraph Company have filed plans at the Building Bureau for a six-story brick, iron and stone building at the southeast corner of Wooster and Spring streets. It will have a frontage of fifty-four feet, be fifty-one feet deep, and cost $150,000.

Bell Telephone Patent Suits.—A special dispatch from Washington of Oct. 25, in the New York *Herald*, quotes Attorney-General Miller as saying: "You can make as public as possible this fact—that the government has determined to press to a speedy conclusion, and with all the forces at command, the suit for fraud against the Bell Telephone Company."

Telephones in Austria.—Long-distance telephonic communication was opened recently in Austria between Vienna and Prague, a distance of 220 miles. Every subscriber in Vienna can now communicate with Prague, and every word can be perfectly understood and the voice recognized. In connection with this news the London *Star* gets rather a good joke on the *Daily News*, which first announced the opening. Their correspondent mentions as a curious fact that it has been observed that those who listen at Prague hear more clearly than those who listen in Vienna, and remarks the reason has not been explained. The *Star* heads its paragraph "They speak plainer in Vienna,' and says the reason seems clear enough.

THE ELECTRIC LIGHT.

Baird, Tex.—Dr. P. L. Clark will put in a plant.

Savannah, Ga.—The De Soto Hotel will put in a plant.

Tampa, Fla.—The Port Tampa Hotel will put in a plant.

New Cumberland, W. Va.—A local electric light company is being formed.

Corning, Ia.—A local company will put in a Westinghouse alternating plant.

Hope, Ark.—The Thomson-Houston Company will put in the municipal plant.

Apalachicola, Fla.—A plant is proposed. Mr. C. Camber worth is interested.

Monroe, N. C.—The Mayor of Monroe will receive estimates for an electric light plant.

Arkadelphia, Ark.—The Arkadelphia Cotton Mill will put in an electric light plant.

Pattersonville, La.—L. S. Clarke is putting in a plant for his Lagonda sugar plantation.

Newport, Ky.—The Newport Light Company has built a new station and increased its plant.

Harrisonburg, Va., is considering a favorable proposition from Baltimore for town lighting.

Helena, Ark.—Mr. B. B. Waddell wants figures, etc., as to an electric light plant for a new hotel.

Centreville, Md.—The new water-works are being so built that an electric plant can be added.

Griffin, Ga.—The Aycock Manufacturing Company have the contract for putting in the Brush plant.

Knoxville, Tenn.—The Knoxville Schuyler Company has been reorganizing and enlarging its plant.

Connellsville, Pa.—An electric light company has been formed at Connellsville, with a capital stock of $20,000.

Fort Worth, Tex.—The mayor wants bids for a city plant of 32 arcs of 1,200 c. p. and over 300 incandescents.

South Pittsburg, Tenn.—The South Pittsburg Electric Light Company is going in for incandescent lighting.

Eckington, D. C.—A plant is being put in for the Soldiers Home by the Eckington Electric Railway Company.

Berkley, Va.—The Tunis Lumber Company are enlarging their lumber mill and putting in an electric light plant.

The Westinghouse Electric Company have added to their list a 5,000-light machine. The new machines will soon be ready.

The International Telegraph District and Call Company, Baltimore, have put in additional plant for 500 incandescent lights.

Durango, Col.—The Durango Electric Light Company has a capital stock of $50,000. T. C. Graden, J. Porter and H. Schiffy are interested.

New Orleans, La.—The Louisiana Electric Light and Power Company has been reorganized, and the Fort Wayne plant will be greatly enlarged.

McKinney, Tex.—The McKinney Electric Light Company has been formed by W. McGary, C. W. Hill and others, with a capital stock of $20,000.

Wabash, Ind.—The Wabash Electric Light Company are about to add incandescent lighting apparatus to their plant, for commercial purposes.

Salisbury, Md.—The Salisbury Electric Light Company has been formed with a capital stock of $30,000. Mr. P. Lee, of Wilmington, Del., is president.

Atlanta, Ga.—The Gate City Gas Light Company and the Atlanta Gas Light Company have amended their charters so as to do an electric lighting business.

Pottsville, Pa.—The Edison Electric Light and Power Company are building a station 40 by 105 feet. It will be run by two Ball engines of 150 h. p. each.

Rico, Col.—The Rico Electric Light and Power Company has been formed by G. S. Barlow, H. R. Woodall and C. W. Corbin with a capital stock of $10,000.

South Berwick, Me.—The Westinghouse Company have secured power from the Portsmouth Cotton Manufacturing Company and will light a large area.

Griffin, Ga.—A local company, with $25,000, has been formed to operate the new Brush plant. Mr. H. C. Burr is president and Mr. J. G. Rhea secretary and treasurer.

Manhattan, Kan.—The Manhattan Elec ric Light Company has been formed by J. B. Anderson, E. A. Wharton and C. G. Garrettson, with a capital stock of $25,000.

Belleville, Ill.—The Electric Light and Coal Company, of Belleville, has been formed by J. Brozius, G. W. Knobeloch and J. E. Thomas, with a capital stock of $70,000.

Camden, Ark.—The new local company will put in a Thomson-Houston arc and incandescent plant. Mr. S. Q. Sevier is president, and Mr. J. B. Friedheim, secretary.

Lighting a News Wagon.—The Elmira, N. Y., *Telegram* has one of its news wagons lighted by electricity, the current being supplied by a small set of storage batteries.

Mitchell, S. D.—The Northwestern Electric Light Company, of St. Paul, will, under an exclusive franchise, put in a Thomson-Houston plant of 30 arcs and 600 incandescents.

Lord Brassey's Seashell Lamps.—Lord Brassey, in his be autiful London house, has inclosed the incandescent lamps in seashells, and the effect is described as simply glorious.

Florence, S. C.—W. R. Barringer has made a proposition to furnish the city with sixty 30-c. p. incandescent lights for $900 per year, if granted exclusive franchise and exemption from taxation for 25 years.

Council Bluffs, Ia.—Soms Omaha parties report that the Sperry Company is negotiating for control of the Council Bluffs Electric Light and Power Company. The price set by Mr. Officer is said to be $60,000.

Clarion, Pa.—A charter has been granted to the Clarion Electric Company, of Clarion, Pa. The capital is $15,000, and the directors are W. A. Hindman, A. L. Ivory, A. C. McComb and S. K. Clarke, all of Clarion.

West Troy, N. Y.—The West Troy Electric Light and Power Company has been formed by G. H. Moseman, G. W. Hunt, H. Tollner, W. B. Lindsay and J. Gallagher with a capital stock of $85,000. It is supplying West Troy.

The National Carbon Works, at Cleveland, were damaged by fire on Sunday Oct. 27, to the extent of some $30,000. This loss is to be deeply regretted, but fortunately the plant was well insured. The company will go right ahead.

Bowling Green, Ky.—The Grand Avenue Cave Hotel Company wants engine for electric light and power plant, electric plant for lighting its cave, which is five miles long, and motor to run elevator from hotel to cave, 150 feet.

Electric Lights for China.—The Westinghouse Electric Light Company has just secured the contract to erect a central station for a very large electric light plant in Pekin, China. The city is to be lighted throughout with incandescent lamps, whose number runs into many thousands.

The Thomson-Houston Electric Company reports the following sales of incandescent apparatus to local companies: Hudson, Mass., 650; Norwalk, Conn., 650; Lebanon, Ky., 300; Newton, Mass., 1,000; So. Framingham, Mass., 500; Eastport, Me., 500; Leominster, Mass., 650; Waltham, Mass., 650; Carlisle, Pa., 1,300; Bradford, Pa., 650; Franklin, Mass., 650; Passaic, N. J., 650; Mt. Vernon, Md., 650; Lancaster, N. H., 650; Atchison, Kan., 650; Vicksburg, Miss., 650; Santa Cruz, Cal., 650; Peoria, Ill., 1,300; Watertown, Wis., 650; Mason City, Iowa, 300; Pana, Ill., 650.

New Arc Plants.—The Thomson-Houston Electric Company reports the following sales of arc apparatus: Joliet, Ill., 100 lights; Waycross, Ga., 50; Springfield, Ohio, 50; Passaic, N. J., 50; Sioux City, Iowa, 85; Bradford, Pa., 50; Peoria, Ill., 405; Lowell, Mass., 25; Fremont, Ohio, 50; Portsmouth, N. H., 30; Grand Rapids, Mich., 50; Rutland, Vt., 35; Belle Plaine, Iowa, 20; Johnstown, Pa., 100; Watertown, Wis., 50; Woburn, Mass., 50; Chicago, Ill., 50; Chelsea, Mass., 30; Ft. Scott, Kan., 70; Dayton, Ohio, 50; Mason City, Iowa, 33; Jersey City, N. J., 200; Germantown, Pa., 50; Worcester, Mass. 50; Philadelphia, Pa. U. S. Co., 50; Rome, N. Y.

The Commercial Electric Company, of Detroit, has made a contract to furnish the Wyandotte Electric Company with a complete electric light plant, which will include the arc and incandescent systems manufactured by the Fort Wayne Electric Company. Wyandotte will commence to light her streets and public offices by electricity about Dec. 10 next. The outdoor lights will be suspended at street intersections. The same company has been awarded a $3,000 contract for wiring and equipping the new Hammond block, opposite the City Hall, with a 1,000 light plant. This is the largest contract of the kind for any single building in Michigan. After the plant is put in, the electric current may be furnished from any of the city companies.

Downington, Pa., enjoys the distinction of being one of the few boroughs in the country which believes in progressing backwards. On Monday, Oct. 7, 1889, the Borough Council rejected a proposal from the Downington Light and Power Company (Electric) for 25 c. p. street lamps, to be lighted every night in the year, at the at the rate of $14.50 per lamp per annum, in favor of a local gas company's price of $12.50 per lamp per annum, each lamp to be lighted for 27 nights per month. Two of the councilmen, Messrs. Tutton and Guthrie, made an earnest effort to have the electric light adopted, and the former made a good speech in its favor, but old fogyism prevailed and the citizens of Downingtown will wade home in semi-darkness for another year.

North Manchester, Ind.—The local *Journal* says: "George Burdge has made the sale of a half interest in his electric light plant to Mr. John W. Boyer, of South Whitley. The amount of the consideration is not made public, but the name of the Jenney Electric Company will be retained by the new firm. This is one of the best equipped plants to be found in the country, and Mr. Burdge was only induced to part with half of it because the business required such constant attention that he was not able to give it the care he wished. Mr. Boyer was formerly in Quebec, Canada, and has had a good deal of practical experience in handling machinery. He will secure a house and take control of his interest in the plant. The new firm will devote all its energies to the business and render a more efficient service than ever."

The Thomson-Houston Electric Company reports the following sales of arc and incandescent apparatus for isolated plants: Knowles Loom Works, Worcester, Mass., 45 arc; Portland Steam Packet Company, Portland, Me., 300; Hopedale Elastic Fabric Company, Hopedale, Mass., 400: Sheffield Worsted Company, Pascoe, R. I., 300; A. L. Sales, Pascoe, R. I., 50 arc; Paine Furniture Company, Boston, Mass., 800; Whitehall Silk Company, Whitehall, N. Y., 800; Helvetia Silk Company, Paterson, N. J., 200; C. B. Rouss, New York City, 78 arc; Vermont Marble Company, W. Rutland, Vt., 56 arc, 150 inc.; George Moore, No. Chelmsford, Mass., 500; Nashville Cotton Mills, Nashville, Tenn., 200; Mariner & Co., Boston, Mass., 50; Coventry Company, Anthony, R. I., 500; the Omaha Republic, Omaha, Neb., 20 arc; Hobbs, Wall & Co., San Francisco, Cal., 30 arc; Verdi Mill Company, Verdi, Nev., 18 arc; Girl's Reform School, Mitchelville, Ia., 150; Hall & Buell, South Manistique, Mich., 75; Bonfield & Co., Bay City, Mich., 150; Conway Cabinet Company, Milwaukee, Wis., 150; People's Railway Company, St. Louis, Mo., 6 arc, 300 inc.; Town of Hope, Hope, Ark., 300.

APPLICATIONS OF POWER.

Staunton, Va.—S. B. & D. Adams propose to put in an electric road.

Syracuse, N. Y.—An electric road is to be built to Fayetteville and Manlius.

Salmon Falls, N. H.—The Salmon Falls Manufacturing Company are putting in an electric railway.

Binghamton, N. Y.—The Sprague system has gone into operation on the Binghamton electric road.

Savannah, Ga.—The Savannah & Suburban Railway Company will probably adopt a storage system.

Sherman, Tex.—The College Park Belt Line Railway Company will put in a Thomson-Houston plant.

The Van Gestel Electric Street Railway Car Company is to be found at 510-514 West 34th street this city.

Baltimore, Md.—The North Avenue Passenger Railway Company proposes to operate by electric or cable power.

Lexington, Ky.—The Lexington (Ky.) City Railway Company will not only adopt electricity, but extend their road.

Dallas, Tex.—The Dallas Rapid Transit Company will put in a Sprague equipment. The contract was secured by Mr. W. T. M. Mottram.

Shreveport, La.—The Shreveport Railway and Land Improvement Company will run two and a half miles of road, using the storage system.

Des Moines, Ia., has seen a consolidation of its street railway enterprises on a basis of $1,000,000. All three roads will now be operated electrically.

Lexington, Ky.—The Lexington City Railroad Company expects to have not less than 12 to 15 miles of electric service. C. H. Stone is the president.

Ashland, Ky.—The Ashland & Catlettsburg Electric Street Railroad Company has a capital stock of $25,000 and has asked for a permit to build its road.

Hamilton, O.—The Hamilton Electric Street Railway Company has bought out the old street railway company, and the whole system will be equipped electrically.

Steubenville, O.—The Steubenville Electric Railway Company is running its Sprague system very satisfactorily, with six cars, at a total cost of $5 50per day, the road being two and a half miles long.

Rochester, N. Y.—The Cross-town Street Railway Company has bought the franchise of the Rochester City & Brighton Street Railway, the Rochester & Lake Ontario Railway, the Rochester & Glenham Railway and the Rochester Electric Railway.

Stillwater, Minn.—The Stillwater Electric Street Railway Company are running their road with the Sprague system at a cost for power of $3 each per day for four cars and $2.25 per car for six cars. The road is five and a quarter miles long, on heavy grades, and with 16 curves.

Memphis, Tenn.—The Memphis Electric Railway has been incorporated by T. H. Allien, Jr., E. R. Thomas, M. B. Trezevant and others, who have asked for a franchise. The Citizens' Street Railroad Company has ordered an electric equipment from the Thomson-Houston Company.

Motors for the U. S. Treasury.—Gen. Rosecrans, Register of the Treasury, has decided to introduce the use of electricity in his office as a motive power to run the punching machines for cancelling the redeemed treasury notes. This change is necessitated by the intense vibration in the walls caused by the shafting, most of which can be dispensed with if electricity is used.

Warrensburg, Mo.—The Electric Springs Railway Company write us: "Our line is completed and in operation for one mile. The contemplated extent is six miles and the franchise is granted for most of the extension. At present we propel our cars by mules, but the franchises allow the use of the electric motor. Over 100 residences have been built here this summer, and all kinds of business are doing well."

Port Huron, Mich., and Gratiot are still running their old Van Depoele electric overhead system with "gratifying success." The Port Huron section has increased its traffic about 100 per cent. in three years, and the Gratiot line makes its runs at the rate of a mile in 3½ minutes. The Port Huron road has five cars and four motor cars, the latter costing for power per day only $5.50. Mr. J. H. Talbot is the secretary.

San Jose, Cal.—The San Jose & Santa Clara Railway Company has closed a contract with the Thomson-Houston Company, through Mr. W. J. Clark, for the construction and equipment of an entirely new road on the overhead system. This will be the first Thomson-Houston road in California and is to be ready in 90 days. The local company says that it spent $234,000 in trying to makes its old underground system a success.

Electricity in the Scranton Mines.—A press dispatch from Scranton, Pa., Oct. 17, says: Electricity for motive power was successfully introduced in the Erie Railway Company's mines at Mayville, to-day, the locomotives easily hauling 27 cars on the planes in the mines. The mines were also lit by electricity. The system being successful will add to the output, and the company will extend it to other collieries. This is the first successful attempt at using electricity for this double purpose in coal mines, and it is regarded as an important move by all coal operators.

PERSONALS.

Mr. R. H. Sherwood has resigned his position with the Excelsior Electric Company and entered the railway department of the Thomson-Houston Company.

Mr. C. F. Heinrichs writes us that there is no truth in the story published by the *Evening Sun* that he was summarily ejected from the office of Coroner Schultze.

Mr. H. P. Brown has an article in the November *North American Review* on electrical execution. It is an attack on the alternating system, such as might be expected from that source.

Mr. W. B. Harvey, night chief operator of the Western Union Telegraph Company at Memphis, has, it is said, invented a very satisfactory "circuit protector" for keeping telegraph circuits clear of trouble, etc.

Dr. J. P. Joule, the distinguished physicist, died near Manchester on Oct. 11 at the age of 71. His determination of the mechanical equivalent of heat, a great work in itself, was but one of his many contributions to scientific advance.

Antonio Meucci, who claimed to have invented the telephone, died in poverty a few days ago at Clifton, Staten Island. His claims as a telephonic inventor were never proven. The old man had a hard and troublous life, and was a friend of Garibaldi.

Mr. H. B. Meech, of Chicago, who has lately returned from a trip through the mining regions of Utah, has devised an electric motor which will deliver a greater per cent. of power at the pulley than is absorbed at the brushes—according to his statements. Possibly he is mistaken.

Gen. C. H. Barney.—The many friends of General Barney, the treasurer of the Sawyer-Man Electric Company, will be pleased to learn of the marriage, on Oct. 31, at Hackensack, N. J., of his daughter, Sarah Lavinia, to Mr. C. H. Carter, of the firm of St. John, Kirkham & Co. There were 800 guests

President C. K. Adams, of Cornell, says of the electrical studies there: "No branch of the university has given evidence of such rapid and remarkable growth as that part of Sibley College which is devoted to electrical engineering. The number of students in that course three years ago was 59. The total number registered in this course at the present time is 166."

Mr. J. H. Vail, who for some time past has been actively engaged as assistant to the president of the Sprague Electric Railway and Motor Company, has now been appointed Chief Engineer of the company. Under this new arrangement he will have full charge and authority over all operating branches of the company's business, and general charge of the conduct of the home offices. Mr. Vail, with characteristic energy, is already deep in the responsibilities of his new work.

Sir Daniel Gooch, the eminent engineer, died in London last week. He was 73 years of age. He was born at Bedlington, Northumberland. He studied the profession of an engineer at Newcastle under Robert Stephenson, and in the large iron works of South Wales. For 27 years he held the position of chief locomotive engineer to the Great Western Railway, and he served as chairman of the board of directors of that company. He was one of the shareholders of the steamship "Great Eastern." He was elected to Parliament for Crickdale in 1865, and about the same time he became chairman of the Telegraph Construction and Maintenance Company and a director in the Anglo-American Cable Company. The dignity of a baronet was conferred upon him after the laying of the Atlantic Cable, Nov. 13, 1866. He was a distinguished Mason.

MISCELLANEOUS NOTES.

The Westinghouse Machine Company report sales for October up to the 21st of 76 engines of 4,090 h. p. The total sales for nine months reach 544 engines aggregating 27,510 h. p.

Another Electrical Sentence.—McElvaine, a murderer, has been condemned to death in this State, and the date of his execution by electricity has been fixed as during the week beginning Dec. 9.

A Phonograph Clock is, it is said, now being devised by Mr. Edison. An amusing account of the possibilities of such an invention may be found in Mr. Bellamy's recent article, "With the Eyes Shut."

The Consolidated Temperature Controlling Company, of Minneapolis, report a steady increase in sales, some 400 installations having been made since June, while 29 orders were received on last Thursday.

More Subways for New York.—At a meeting of the Board of Aldermen last week it was resolved that Commissioner of Public Works Gilroy be authorized to grant permits to build subways. All such subways are to be completed before Dec. 15.

The Anaconda Copper Company will build a large new electric process copper refinery at Three Forks, Gallatin County, Mont. At present nearly all the copper manufactured at the smelters of the Anaconda is sent to Swansea, Wales, to be refined.

A Fashionable Wedding took place on Oct. 15 at Morristown, N. J., when the only daughter of Mr. C. F. Cutler was married to Mr. J. B. Curtis, of Indianapolis. A number of well-known telephone officials witnessed the ceremony and were among the guests.

The Victor Turbine.—The Académie Nationale de France has awarded its grand gold medal to the Victor Turbine now being exhibited by the Stilwell & Bierce Manufacturing Company at the Paris Exposition. This is a gratifying testimonial to the excellence of American design and workmanship in hydraulic apparatus of this class.

Messrs. John A. Roebling's Sons Company, after trying the Aerated Fuel Company's system on their wire furnaces for a month, have recently placed an order with W. S. Collins, licensee, 171 Broadway, New York, for seventy-two burners to fit up thirty-six of their large furnaces. Mr. Collins reports other important orders lately from old as well as new customers.

William Interested in Gerricide.—The German Emperor has instructed the ministry of justice to report on execution by electricity. He is in favor of this method of execution if it will produce painless death with absolute certainty. He reads everything obtainable on the scientific side of the question, and has sent the ministry copious notes on the American and European scientists' inquiries into the matter.

A Progressive Publication.—The October 15 issue of *Progressive Age* is the largest number of a gas publication ever issued in this country. The paper was printed by gas power, and thus *Progressive Age* is the first and only gas journal printed by gas engine. The engine is an "Otto," built specially for our contemporary. The issue in question is devoted to a full report of the Baltimore gas convention.

New York Subway Stock.—On the Real Estate Exchange last week were sold 2,450 shares of Consolidated Telegraph and Electrical Company stock, which had been hypothecated. This is the company which received from the Board of Electrical Control the contract to build conduits. The par value of the shares is $100, but a block of 1,233 shares only brought $10 a share. The price for the remainder was $9 per share.

The Pittsburgh Reduction Company, whose electrical process we illustrated and described recently, have made a surprising cut in the prices of aluminium in the form of ingots. They

announce 1,000-pound lots at $2 per pound, 500-pound lots at $2.25 per pound, 100-pound lots at $2.50 per pound, 50-pound lots at $3 per pound, and small lots at $4 per pound. The lowest quotations heretofore on aluminium have been $4 per pound, and within a short time as much as $6.

An Electrical Offertory-Box.—"An electrical offertory box, which rings a bell whenever a button or a piece of tin is deposited in it, is the latest thing 'over the way.' Mr. Edison should adapt his phonograph to the same purpose. Then, when the stingy millionaire deposits his niggardly contribution, the box would announce in clear nasal tones: 'Dives A. Crœsus resides on Fifth avenue, and has an income of $50,000. He has given ten cents. Next, please.'"—*London Globe.*

The U. S. Patent Office.—The *Official Gazette* of the U. S. Patent Office, beginning with the first issue of November, will publish each week the condition of business in the various examining divisions of the office. This information will be of use to inventors, inasmuch as they can ascertain at any time how long their applications will remain in the office before action. The Patent Office has also published a volume containing a list of women inventors to whom patents have been granted by the United States, from 1790 to July 1, 1888. Forty-four pages, paper covers. Price 50 cents.

St. Louis, Mo.—The directors of the Mound City Coupé and Messenger Company, St. Louis, held a meeting Oct. 26 at the company's office, at Eighteenth and Pine streets. This company was formerly organized as the St. Louis Hansom Cab Company, with a capital stock of $35,000. The company has bought out two or three other messenger companies, and is doing a thriving business. At the meeting yesterday the name was changed to the Mound City Coupé, Livery and Messenger Company, and the capital stock was increased from $35,000 to $200,000. The firm will do a livery business in connection with its messenger service.

How to Use Gas.—There is a Thomson-Houston exhibit at the Mechanics' Fair, that shows well the saving when gas is used as a fuel instead of an illuminant. An Otto silent gas engine is used. During the evening's run at the fair, the gas engine working the Thomson-Houston electric plant consumes 300 cubic feet of gas, and furnishes fifty-three 16-c. p. incandescent lights, while fifty-three 16-c. p. gas lights, with 5-foot burners, would require 618 feet for the same length of time. This is a saving of over 50 per cent., and would in a short time pay for the first outlay of an electric plant, and the consumer would have the benefit of a brighter and more attractive light.—*Pacific Lumberman.*

Emperor William is greatly interested in the phonograph, and took care that the voices of his three sons should be the first children's voices ever preserved by a phonograph in Germany. Each of the little princes had to speak a sentence, and when the youngest one's turn came, he said, "Papa, I would like to have a pony." The Empress has carefully preserved the rolls on which these sentences were spoken. An actor, Herr Reicher, had previously confided a scene from "Hamlet" to the phonograph, which, in repeating it, called his attention to imperfections in his enunciation. This prompted the Emperor to suggest that a phonograph should be introduced in every German high school, as a sort of instructive vocal mirror.

Damages for Dismissal.—The first of a number of suits brought by Charles R. Johnson against the Union Switch and Signal Company, of which George Westinghouse, Sr., is president, was brought to trial last week before Chief Justice Sedgwick and a jury, Part I. of the Superior Court, in this city. After a protracted trial the jury rendered a verdict in favor of Mr. Johnson and against the Union Switch and Signal Company for the sum of $4,155.67, for which sum, besides costs and five per cent. additional allowance by the court, judgment was entered later. The action was for damages for breach of contract under which the plaintiff had for some time acted as general manager of the company, and which the plaintiff claimed was broken by his unwarranted dismissal before the end of the term for which he had been engaged. The company admitted the breach, but tried to justify it, and the jury found all the issues in plaintiff's favor, and assessed the damages as above stated. The case was tried by Geo. W. Miller, of Miller & Savage, for plaintiff, and by Mr. Hughes, of Carter, Hughes & Cravath, for the company.

Copper for the Westinghouse Company.—A special dispatch of Oct. 29, from Pittsburgh, says: "George Westinghouse, of this city, has just concluded the purchase of some valuable copper mines in Washington Camp, Arizona, the production of which will be used at the works of the Westinghouse Electric Company. An application for the charter of the Duquesne Mining and Reduction Company will be made to the Governor on Nov. 20, and this company will operate the mines in Arizona. The incorporators are George Westinghouse, Jr., Charles A. Ashburner, John Caldwell, H. H. Westinghouse and Walter D. Uptegraff The electric company uses several million pounds of copper every year in the manufacture of electrical machinery, and by having its own mines the saving in the cost of copper will amount to a considerable sum each year. It is also intended to get beyond reach of the proposed Lake Superior copper syndicate. The mine will give employment to about three hundred men. Charles A. Ashburner, the geologist, will leave for Arizona next Thursday, and personally superintend the work of starting the operation of the mine."

BUSINESS NOTICES.

Battery Cut-Out.—Attention is called to a simple device for disconnecting gas-lighting batteries if accidentally grounded. It is cheap, sensitive, never needs watching, and has no clockwork to be kept wound. Terms furnished by the Electric Supply Company, of Syracuse, N. Y., No. 105 South Warren street.

W. R. Ostrander & Co., of 21, 23 and 25 Ann street, this city, have just issued the seventh edition of their revised catalogue. It includes a large number of new goods, and shows a great variety of excellent electrical call and alarm apparatus, as well as pneumatic tubes, mechanical door bells, etc. This catalogue is now over 100 pages, and is profusely illustrated.

Houston's Electrical Dictionary is in receipt of favorable reviews and notices everywhere. One of the latest comes from the San Francisco *Argonaut* of Oct. 28, which says:

"The rapid growth of electrical science and its intimacy with the affairs of every-day life have made a dictionary of electrical terms a necessity, and to fill this want "A Dictionary of Electrical Words, Terms, and Phrases" has been prepared by Edwin J. Houston, a well-known scientist. The work is a popular one, bringing together the technical words which have been coming to life of late in the electrical journals and many of which have not yet found their way into the dictionaries; these are here defined in exact phrases, but so clearly stated that, with the aid of the many illustrative cuts, they are clearly intelligible to the lay reader. The book is of handy size and shape, contains more than six hundred and fifty pages, and is well printed."

"New Process Raw-Hide" is being introduced by the New Process Raw-Hide Company, of Syracuse, N. Y. It is remarkably well adapted for use in gears for electric railways and other electric power transmission apparatus. It not only wears splendidly, but is practically noiseless. They do not cut the teeth, but furnish the blanks either rough or turned to exact size and with the hole bored. Another very desirable feature is their great lightness. These gears are destined to find a wide appreciation among electrical engineers. Mr. T. W. Meachem is the president and general manager of the company, and the Hon. W. B. Kirk, the popular millionaire Mayor of Syracuse, is vice-president. A letter from the Roaring Fork Electric Light and Power Company, at Aspen, Col., says: "We have been using your raw-hide gears on our electric motors for hoisting in the mines here. They do away with all disagreeable noise, and are giving us perfect satisfaction. Some of the gears have been in constant use day and night for fifteen months and are very little worn. The raw-hide is not strengthened by metal in any manner."

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

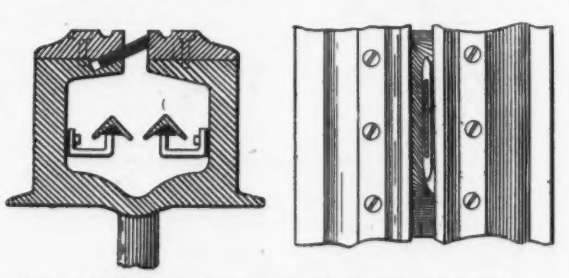
PATENTS ISSUED OCT. 22, 1889.

413,160. Electric Car-Lighting; Sidney H. Barrett, of Springfield, Mass., Assignor to Dwight Holland, of same place. Application filed Feb. 24, 1888. An engine on the train derives its steam from the locomotive and drives a dynamo. The train is also equipped with storage batteries, and the incandescent circuit is arranged to be fed by either the dynamo or the batteries.

413,215. Underground Conduit; George Henry Warde, of New York, N. Y., Assignor to William Hampden Johnstone, of Philadelphia, Pa. Application filed May 9, 1889. The combination of a test-box, an armored or lead-covered cable extending through an opening in the box, a collar secured to the cable and fitting said opening, and having a flange exterior to the box, and clamping devices on the collar within the box.

413,220. Holding Attachment for Arc Lamps; Thomas H. Brady, of New Britain, Conn. Application filed March 5, 1889. The lamp globe is supported upon an adjustable socket fixed to the top of the pole.

413,276. Central Station Calling Apparatus; Isaiah H. Farnham, of Malden, Mass. Assignor to the New England Telephone and Telegraph Company, of New York. Applications filed April 20, 1889. The combination in a call apparatus for telephone exchanges, of a series of magneto-electric generators operated by power, connecting wires extending therefrom to the signal sending appliances of a series of telephone switchboard sections, each of the wires being adapted to form part of a sub-station circuit for sending outgoing signals. A distributing switchboard placed in the circuit of the wires between the generators and the telephone switch board, and means are provided for testing the generators and their connecting wires.



NO. 413,294.—CONDUIT FOR ELECTRIC RAILWAYS.

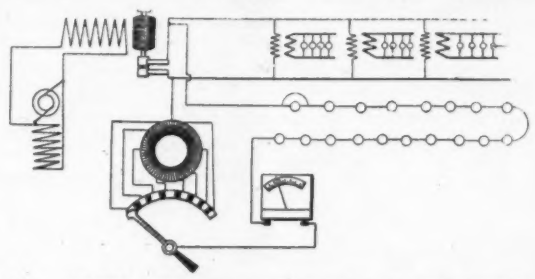
413,279. Electric Regulator; William Hochhausen, of Brooklyn, N. Y. Application filed March 12, 1889. In an electric regulator, the combination, with a series of carbon sticks or pencils, forming an electric resistance, of a series of blocks each having two contact seats or sockets receiving pairs of the pencils at one end, and a second series of spring plate sockets secured in pairs to a common conducting support, each spring socket of a pair receiving the ends of rods or pencils resting at their opposite ends in adjoining blocks.

413,280. Switch for Dynamo-Electric Machine; William Hochhausen, of Brooklyn, N. Y. Application filed March 12, 1889. The combination with a dynamo-electric machine of a switch connected to a field magnet coil of the machine, a shunt coil connected to the contact of a switch, an artificial resistance and means controlled by the switch for introducing such resistance gradually into the circuit containing the coil immediately before the completion of the shunt.

413,281. Electric Pendulum-Driven Clock; Marcus L. M. Hussey, of Menlo Park, N. J. Application filed Aug. 27, 1888. In a clock, the combination, with the pendulum rod hung or pivoted at a point below its upper end, of an armature on the pendulum rod, electro-magnets between which the armature vibrates with the oscillations of the pendulum, a battery cell or cells, or other source of electrical energy, and a circuit changing device operated by the oscillations of the pendulum, which device operates to alternately magnetize and demagnetize the electro magnets.

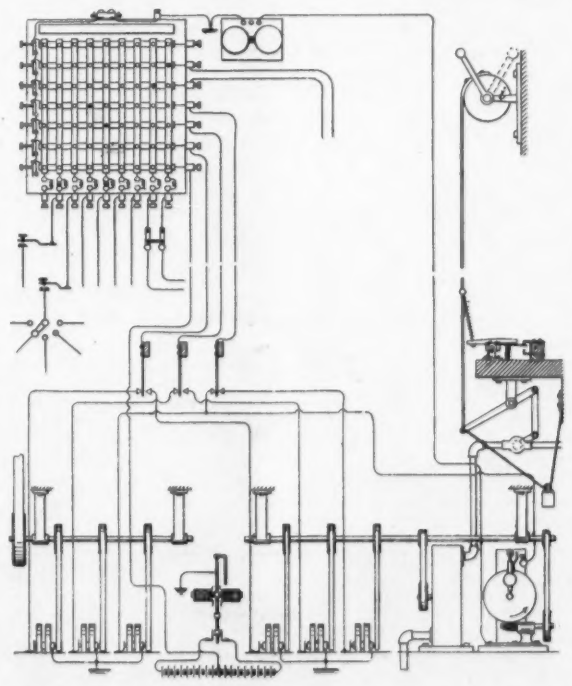
413,287. Contact Trolley for Electric Railway Cars; James Mitchell, of Des Moines, Ia. Application filed June 21, 1889. The combination, with the trolley arm or pole, of a bearing for the trolley vertically swiveled on the end of the arm so as to permit the trolley to turn in a substantially horizontal plane into different angular positions with reference to the arm or pole.

413,292. Electric Measuring Instrument; Elihu Thomson, of Lynn, Mass., Assignor to the Thomson-Houston Electric Company, of Connecticut. Application filed April 28, 1887. The combination, with an electric conductor carrying an electric current, of a mass of iron partially embracing the conductor and adapted to form through its whole range of movement from zero a partial magnetic circuit around the same, and movable in the general longitudinal direction of the conductor to positions where it will gradually effect a change in the degree of closure of the magnetic field around the conductor.



NO. 413,292.—SYSTEM OF ELECTRIC DISTRIBUTION.

413,293. System of Electrical Distribution; Elihu Thomson and Edwin Wilbur Rice, Jr., of Lynn, Mass. Application filed July 30, 1888. A system of electrical distribution comprising constant potential mains having translating devices of any desired character in multiple between them, a series circuit of distribution connected across the mains and containing translating devices in series, and a current regulator in the series circuit. See illustration.



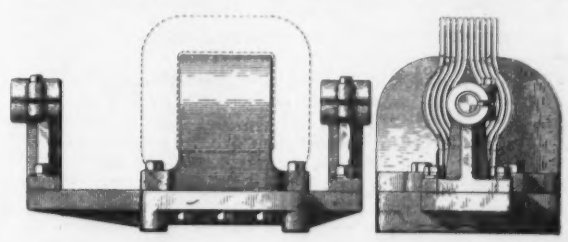
NO. 413 276.—CENTRAL STATION CALLING APPARATUS.

413,294. Conduit for Electric Railways; Elihu Thomson, of Lynn, Mass. Application filed March 5, 1889. The invention consists in closing the slot of the conduit with a brush or broom-like septum or guard, the fibres of which extend transversely into the slot from the side thereof. One brush extending across the slot thereof may be used, or two meeting at their free ends in the slot may be employed. The brush effectually closes the slot, although not solidly, because of the capillary action of the spaces between the fibres or individual stems making up the brush or broom, while its springy nature enables it to yield in the direction of the slot to permit the plow or bar carried by the car and supporting the contact shoes or brushes within the conduit to pass. See illustration.

413,308. Telephone Receiver; Charles Selden, of Baltimore, Md, Application filed Jan. 6, 1885. For description see page 297, last issue.

413,337. Dynamo-Electric Machine; Rudolf Eickemeyer, of Yonkers, N. Y. Application filed Feb. 8, 1889. In a dynamo electric machine, the combination of a rectangular frame having a top and bottom which serve as portions of an electro-magnet, and ends which couple the top and bottom and serve as standards for an armature shaft, a field coil substantially rectangular in outline mounted within and parallel with the top and bottom of the frame, and concaved cheek pieces which are bolted to the opposite edges of the frame at top and bottom, having a width substantially equal to the interior length of the coil, confine the coil in place, and afford between their concave faces and within the coil a cylindrical space for the reception of an armature of appropriate length and diameter.

413,338. Magnetic Gauge for Testing the Magnetic Conductivity of Metals; Rudolf Eickemeyer, of Yonkers, N. Y. Application filed February 23, 1889. In a magnetic gauge for testing the magnetic conductivity of metals, a central magnetic field, two or more contact faces located within an external or on outer magnetic field and adapted to receive pieces of metal to be tested, and a magnetic indicator which is normally uninfluenced by the central field in its normal condition, but will respond to changes or variations in the central field resulting from changes or variations in the outer field as when any two of the contact faces are temporarily connected by metal having more or less magnetic conductivity.



NO. 413,363.—DYNAMO ELECTRIC MACHINE.

413,339. Secondary Battery; Rudolf Eickemeyer, of Yonkers, N. Y. Application filed March 7, 1889. In a secondary battery the combination of a suitable clamp and two or more counterpart lead castings or foundations insulated from each other, and each provided with holes or recesses lined or coated with active material which register with similarly lined or coated holes or recesses in the next adjacent casting or foundation and afford spaces or cells for the reception of the electrolyte. See illus.

413,340. Electric Regulator for Pendulum Clocks; James H. Gerry, of Brooklyn, N. Y. Application filed August 9, 1889. In a clock, the combination, with a threaded spindle for adjusting the vibrating length of the pendulum and a ratchet-wheel secured thereto, of an oscillating armature, pawls carried thereby and adapted to engage with the ratchet on opposite sides of its axis, electro-magnets on opposite sides of the armature, and circuit controlling mechanism adapted to energize one or the other of the magnets.

413,345. Galvanic Battery Compound; William P. Kookogey, of Brooklyn, Assignor to the Kookogey Electric Company, of New York, N. Y. Application filed Dec. 14, 1886. A battery compound consisting of bisulphate of soda and trioxide of chromium.

413,353. Method of Obtaining Direct from Alternating Currents; N. Tesla, of Pittsburgh, Pa. Application filed June 12, 1889. For description see page 290 last issue.

413,363. Dynamo Electric Machine; Rudolf Eickemeyer, of Yonkers, N. Y. Application filed Feb. 2, 1889. In a dynamo electric machine the combination of an armature having a core of magnetic

metal, cheek pieces, which are connected at their bases in magnetic circuit and correspond in length with the length of the armature, and a field coil which directly polarizes the armature, is partially enclosed at its lower side by the cheek pieces at their bases and has its upper side and its ends wholly exposed to the open air, whereby a completed magnetic circuit is afforded through the cheek pieces and the armature and field coils freely exposed to cooling influences. See illustration.

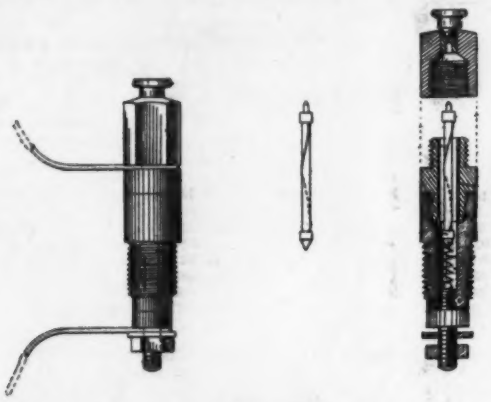
413,409. Railway Train Signal; Daniel D. McElroy, of New York, N. Y. Application filed Feb. 28, 1889. The invention consists in the combination, with the railway track and locomotive or car running upon the track, of an insulated conductor supported parallel with or near the track and grounded at each end, a series of induction coils carried by the locomotive or tender, a relay, signal box and generator also carried by the locomotive or tender, an electric current generator arranged at a fixed station, with a signal box or annunciator and a transmitting key.

(1) 413,410. Electro-Magnetic Railway Signal; (2) 413,411. Electro Magnet; (3) 413,412. Electrically Operated Railway Switch; Daniel S. McElroy, of New York, N. Y. Applications filed (1) and (2), May 16, 1889; (3), June 4, 1889. (1) In an electro-magnetic railway signal the combination of a series of electro-magnets arranged parallel with the track, an alarm device carried by the locomotive, a chain connected to the alarm device, and an armature connected to and supported by the chain within the influence of the magnets. (2) A circular magnet, consisting of a series of sections, each formed of an annular yoke having extensions and coils wound on the extensions. (3) The combination with movable switch rails on a shifting bar connecting the same, a spring and electro-magnet for alternately shifting the bar in opposite directions, an additional bar connecting such rails and provided with apertures, a spring-actuated bolt for locking the latter bar, an armature fixedly and directly secured to the locking-bar and a separate and independent magnet directly controlling such armature.

413,429. Cable Terminal Head and Protector; Ellis B. Baker, of New Haven, Conn. Application filed May 23, 1889. An improved connecting device consisting of a box-shaped terminal head having bolts passing through its sides and connected inside to the respective wires, and on the outside having spring plates fixed by one end thereto, a metal earth bar facing the free end of the row plates, and separately removable interposed slips of non-ducting material.

413,436. Electric Signaling Apparatus; William E. Ducrow, of Boston, Mass., Assignor to the Gamewell Fire Alarm Telegraph Company, of New York, N. Y. Application filed April 1, 1889. In accordance with this invention, an operator at any one of the transmitting or sub-stations may, by the act of swinging the lever through any one of the several different distances of arcs, cause a record to be made at the receiving or main station, as, for instance, by printing on a strip of paper, characters to designate the number of the sub station, and also, when the lever is swung through a certain one of the arcs to bring into action an audible signal, as the ringing of a bell, and through another of the arcs bring into action a visible signal, as by means of an indicator which will display the number of the sub station.

413,442. Incandescent Lamps; Emil F. Gennert, of New York, N. Y. Assignor to the E. P. Gleason Manufacturing Company, of same place. Application filed May 29, 1889. This invention relates to the construction of globes or lanterns for incandescent electric lamps for the purpose of affording the latter a vapor tight inclosure, so as to preserve the lamp and its parts from the possibility of a short circuit being produced by the deposition of vapor of any kind thereon.



No. 413,813.—COMBINED BINDING POST AND THERMAL CUT-OUT.

413,504. Annunciator; Frank E. Fisher, of Detroit, Mich. Application filed June 6, 1889. The combination in an annunciator, of an electro-magnet and an axially oscillatory armature carrying a needle and extending beneath and bodily raised by the two poles of the electric magnet.

413,512. Electric Switch; Robert Carter Hull, of Baltimore, Md. Application filed July 9, 1889. The combination of a contact lever, resistance traversed thereby, a beam connected with the lever, a handle bar, and a sliding connection between the beam and handle bar.

413,604. Electric Railway; Rudolph M. Hunter, of Philadelphia, Pa. Assignor by mesne assignments to the Thomson-Houston Electric Company, of Boston, Mass. Application filed July 13, 1889. In an electric railway, the combination of a traveling vehicle, a stationary source of electric supply, a bared working conductor extending along the path of the vehicle, and a current-collector device of less width than the diameter of the wheel, and supported immediately outside of the wheel of the vehicle and upon the axle box.

413,636. Electric Lamp; Jean Theodore Van Gestel, of New York, N. Y., Assignor to the Van Gestel Electric Street Car Company, of same place. Application filed Aug. 17, 1888. A wall bracket for an incandescent lamp, consisting of an oblong sustaining frame having a depression or groove, in combination with a tubular incandescent lamp held in place in said groove.

413,637. Electric Railway System; Malone Wheless, of Washington, D. C., Assignor of one-half to Samuel E. Wheatley, of same place. Application filed July 22, 1889. The object of the invention is a system for propelling cars by electricity, which consists substantially in causing electro-magnets placed in a conduit to open the line in the conduit, and thereby circuit the dynamo current through the motor on the car.

PATENTS ISSUED OCT. 29, 1889.

413,703. Multiple Thermal Cut-Out; Alexander Wurts, of Pittsburgh, Pa., Assignor to the Westinghouse Electric Co., of the same place. Application filed July 21, 1889. The invention consists in forming a shunt circuit around the fusible strip so constructed as to receive the entire current immediately upon the destruction of the fusible strip, and then itself become interrupted in such a manner as to form an opening of the circuit.

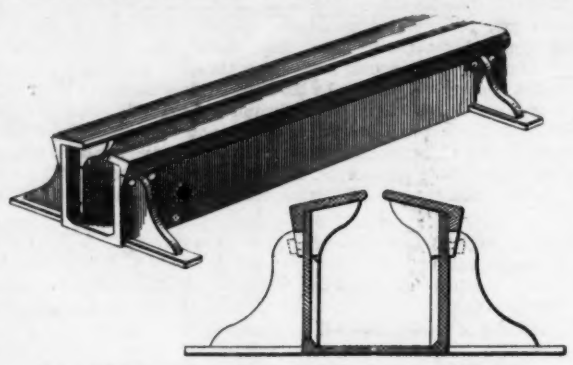
413,707. Metallic Circuit; Henry F. Campbell, of Malden, Mass. Application filed April 9, 1889. The invention consists, essentially, in the combination, with a metallic circuit composed of two branches of wires, of a separator of textile material wound about the branches throughout the length of the circuit to separate and yet bind the said branches.

413,708. Electric Safety Lamp for Miners; Theophilus Coad, of Forest Gate, County of Essex, England. Application filed May 21, 1889. Patented in England, Jan. 5, 1884. A portable electric safety lamp for miners, having a battery, an incandescent lamp suitably connected thereto within an air-tight glass envelope, a passage for the introduction of air into a glass envelope arranged to be closed, and a movable contact point arranged to complete the circuit on depression, normally held out of circuit by a spring appliance having one of the connections for the lamp attached to a flexible diaphragm within the glass envelope operated by a pressure of air to depress the movable contact point to complete the circuit.

413,731. Conduit for Electric Railways; Cecil Percy Poole, of Lynchburgh, Va. Application filed March 23, 1889. The combination, with a metallic box or trough having interior stay ribs, with supporting shoulders at the upper ends, also having exterior laterally projecting base flanges and brace webs, of slot rails resting on the upper edges of the box sides, having bracket braces inside of the box and resting on the shoulders of the stay ribs; also having outside flanges resting on the brace webs and provided with downwardly projecting lips embracing the brace webs and bolted to the box sides. See illustrations.

413,735. Method of Automatically Closing an Interrupted Electric Circuit; Leonard Schaffer, of Boston, Mass., Assignor to the Westinghouse Company, of Pittsburgh, Pa. Application filed Feb. 16, 1889. The method of automatically closing a normally open circuit between two given points upon the interruption of a normally closed circuit between the same points, which consists in utilizing a momentary current of abnormal potential, caused by the inductive discharge of an electro-magnet included in the circuit, to act upon an interposed fusible material in such a manner as to permanently complete the normally open circuit. See illustration.

413,782. Telephone Diaphragm; Alexander Wilford Hall, of New York, N. Y. Application filed Jan. 23, 1889. The combination of a diaphragm for a telephone, phonograph, or other instrument divided radially into sections from the periphery toward



No. 413,731.—CONDUIT FOR ELECTRIC RAILWAY.

the centre; a pair of clamping rings and screws therefor, common to all the sections; a circular bearing, common to all of the sections and tension screws, for drawing the clasping rings over the bearing, and so applying tension to all of the sections.

413,795. Anti-Induction System; John O. Stockwell, of Burlington, Kansas, and Albert Barrett, of Kansas City, Mo. Application filed Feb. 26, 1889. Means for preventing inductive effects on electric signaling lines, consisting of a shunt or loop in closed relation to the line in the neighborhood of inductive disturbance, the return circuit for the line being out of inductive range of the disturbing source.

413,810. Transformer for Converter for Alternating Electric Currents; Leonard Paget, of New York, N. Y. Assignor of one-half to Charles J. Kintner, of same place. Application filed Feb. 12, 1889. A transformer or converter having a primary coil connected in circuit with a source of electrical energy, and a secondary coil connected in circuit with one or more translating devices, with means located directly in one leg or branch of the secondary circuit for regulating the energy required in the primary circuit in accordance with the demands of the translating devices.

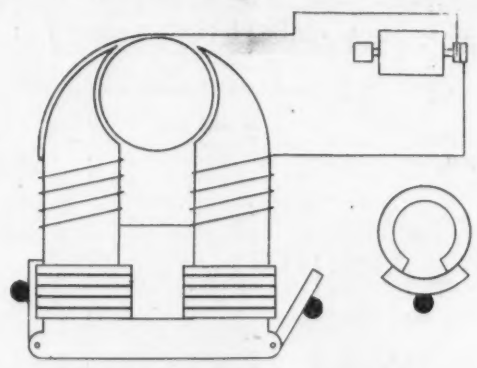
413,812. Galvanometer; Andrew Montgomery Ritchie, of Brookline, Mass. Application filed January 18, 1889. The invention relates to improvemets in the Thomson reflecting galvanometer, with two or four coils, in which the system of magnetic needles carrying the reflecting mirror is suspended by a fiber between the coils of wire, so that the needles are practically inclosed between the centres of the coils.

413,813. Combined Binding Post and Thermal Cut-Out; Howard C. Root, of Brooklyn, N. Y., Assignor of one-half to John C. Reilly, of same place. Application filed June 17, 1889. The combined connector and safety catch comprising two metallic binding posts insulated from each other, but rigidly in line, and a non-conducting fuse carrier having metal tips connected by a fusible strip and held between the posts by a spring at one end and at the other by a removable abutting screw passing through one of the posts in line with the fuse carrier. See illustration.

413,818. Device for Suspending Electric Conductors for Electric Railways; Thomas E. Adams, Cleveland, O. Application filed July 24, 1889. The combination, with a hanger provided with laterally projecting arms and a conductor, of a sheet metal clip bent around the conductor and the arms and securing the conductor to the hanger.

413,848. Telegraph-Key; Eugene S. Crull, of Mount Carmel, Ill. Application filed March 21, 1889. The invention consists in a key lever provided with an annular bearing, the head or support having adjusting screws for supporting and adjusting the balls of the ball-bearing of the key-lever.

413,879. Electric Train Signal; William Winder, of Portsmouth, N. H. Application filed Aug. 8, 1889. The object of the invention is to construct the couplings and connections so as to



No. 414,043.—ELECTRIC REGULATOR.

insure more perfect electrical contacts and insulation and greater durability than heretofore.

413,984. Electric Current Regulator; Frank Thone, of Davenport, Iowa. Application filed March 22, 1889. In combination with the shaft, spiders mounted loosely thereupon and carrying the armature, a spider secured rigidly upon the shaft between the spiders, springs connecting the spider and armature, a regulator and a sleeve or collar mounted upon the shaft and connected with a moving part of the regulator.

413,986. Alternate Current Induction Motor; Charles J. Van Depoele, of Lynn, Mass. Application filed July 29, 1889. An electro dynamic motor for use with alternating or intermittent currents, comprising an armature wound with closed circuit conductors, an exterior field magnet system acting to polarize the armature core, and a stationary secondary field magnet system within the armature for reacting upon the poles induced by the exterior field magnet, and then in turn creating other poles to be reacted upon by the exterior field magnet, and vice versa.

414,043. Electric Regulator; Ludwig Gutmann, of Fort Wayne, Ind. Application filed Dec. 5, 1888. In an electric motor regulator, the combination of one set of coils connected in circuit with an alternating current generator and mounted upon the arms of the field magnet of the motor, and a set of rings of conducting material mounted on the same field magnet core and provided with openings or slots, and a circuit closer for the openings, the closers adapted to open and close the openings. See illustration.

414,049. Electric Railway; Rudolph M. Hunter, of Philadelphia, Pa. Assignor by mesne assignments to the Thomson-Houston Electric Company, of Boston, Mass. Application filed April 2, 1889. In an electric railway, two working conductors, a source of electrical energy, two or more electrically propelled vehicles in multiple arc connection and receiving current from the conductors, and shunt circuits upon the vehicles to shunt a portion of the current around the motors.

414,050. Electric Railway; Rudolph M. Hunter, of Philadelphia, Pa., Assignor by mesne assignments to the Thomson-Houston Electric Company, of Boston, Mass. Application filed April 8, 1889. In an electric railway, the combination of the main or traffic rails, a slotted conduit, one or more longitudinal working conductors arranged along the railway within the conduit and divided into sections, one or more continuous main or supply conductors normally connected with each of the sections of working conductors, a source of electric supply connecting with the main conductor, and a motor mounted upon a car traveling upon the traffic rails and provided with suitable current-collecting devices extending into the conduit and bearing upon the longitudinal working conductor or conductors.

414,052. Method of Regulating Electric Motors; Moritz Immisch, of London, County of Middlesex, Eng. Application filed Feb. 2, 1888. Patented in England, March 2, 1886; in France, March 24, 1886; in Belgium, March 25, 1886; in Canada, Feb. 17, 1887; in Victoria, Feb. 18, 1887; in New Zealand, May 25, 1887, and in India, June 14, 1887. The method of operating electric motors with constant lead, which consists in short-circuiting opposite armature coils successively and maintaining a continuous operative electrical connection between the terminals thereof during the entire time the coils are passing at the neutral zone through an arc equal to the length of one coil section of the armature, whereby when the positions of the polar points of the field magnets change with varying load and speed the short-circuited coils will themselves generate currents acting to correct distortion of the field of force.

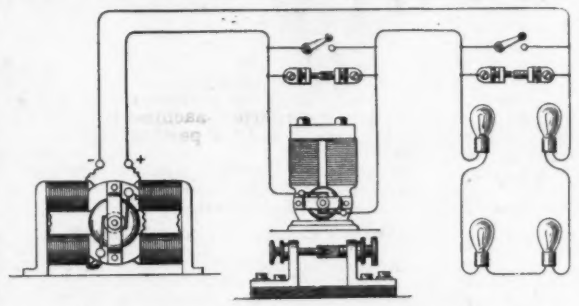
414,076. Electric Current Generator; Gustav Pfannkuche, of Cleveland, O. Application filed July 30, 1889. In an electric current indicator, the combination, with a magnet included in a circuit conveying an alternating, pulsating, or intermittent electric current, of a liquid receptacle, an elastic diaphragm provided with an armature and connected with the liquid receptacle, and an indicating tube connected with the liquid receptacle, the diaphragm and tube being arranged in a vertical position.

414,081. Diaphragm for Galvanic Batteries; Isaiah L. Roberts, of Brooklyn, Assignor to the Roberts-Brevoort Electric Company, Limited, of New York. Application filed May 5, 1887. A separating partition or diaphragm for an electric battery, consisting of a porous substance having its pores closed with gelatinized silicate of soda or potash.

414,085. Electric Mechanism for Operating Telephone Call Bells; Frederick W. A. Schneider, of Toronto, Ontario, Canada. Application filed March 11, 1889. Consists, essentially, of a telephone call bell and annunciator so connected to the telephonic circuit that, upon being signaled, its action breaks the circuit leading to the magnets of the call-bell and switches it onto a line leading to the magnets of an auxiliary call bell situated at a point remote from the telephone.

414,130. Arc Lamp; Friedrich Wilhelm Richard Seifert, of Altoona, Pa., Assignor to Otto Lindemann, of Hamburg, Germany. Application filed June 27, 1889. The combination, with a coaxially arranged solenoid, and the central diamagnetic tube, of the core pending in the tube, the two semi-cylindrical or globular jaws in contact with the core, and the springs or articulated rods connected at their lower ends to the core and at their ends to the jaws.

414,132. Telephone Supporting Device; Samuel J. Adams, of Detroit, Mich., Assignor of three-fourths to Jacob Brown and Arthur Brown, of same place. Application filed May 28, 1889. In a telephone supporting device, the combiaation, with



No. 413,735.—METHOD OF AUTOMATICALLY CLOSING AN INTERRUPTED ELECTRIC CIRCUIT.

two jaws adapted to clamp a movable supporting rod between them, of a rotatable disc carrying thereon a cam adapted to press the jaws together, a movable lever adapted to engage with the disc in one direction, and a spring adapted to hold the lever normally in one position.

414,141. Arc Lamp; Frederic George Chapman and Fred. Mitchell Dearing, of London, Eng., Assignors of one-third to William George Chapman, of same place. Application filed Sept. 27, 1888. Patented in England, May 13, 1887; in France, May 13, 1888; in Belgium, May 13, 1888; and in Germany, April 4, 1888. In combination with a vertical negative carbon, its guide and feeding and adjusting devices, a two part positive carbon provided with notches in its outer ends, tubular horizontal guides for the same, each provided near the arc position with a pair of contact rollers, one of which is spring pressed, plugs working in the guides having wedge-shaped ends fitting into the notches, a feed drum and connections, and conducting supports for the guides.

414,155. Electric Fire Signal; Charles B. Head, of Allegheny, Pa. Application filed April 15, 1889. In an electric signaling apparatus, the combination, with an electric circuit embracing a battery and signaling device, of two rigid terminals, one of which is provided with a cup into which the other terminal dips, an interposed insulator which separates the rigid terminals, and an interposed fusible plug.

414,170. Mechanical Telephone Exchange; George Frederick Shaver, of New York, N. Y., Assignor to the Shaver Corporation, of same place. Application filed March 11, 1889. A movable vibrator, for connecting mechanical telephone lines, consisting of a spring terminating in a hook at either end and provided with a damper, in combination with a tension setting device and a series of mechanical telephone line terminals, whereby parallel lines may be connected together through the vibrator for inter-communication without loss of power or distinctness of articulation.

414,172. Electric Railway; Frank J. Sprague and Patrick F. O'Shaughnessy, of New York, N. Y., Assignors to the Sprague Electric Railway and Motor Company, of same place. Application filed Sept. 7, 1889. The combination, with an electric railway car, of a contact device carried thereby, a support for the contact device, and two springs forming parts of the support, one permitting longitudinal inclination of the support and a stop for the last-named spring preventing the yielding thereof longitudinally of the car.

PATENT EXPIRED OCT. 29, 1889.

132,569. Improvement in Electro-Magnetic Meters; Samuel Gardiner, Jr., of New York, N. Y. It consists of a system of cog-wheels driven by a weight or spring, the same being so arranged with relation to each other that when in operation they record on the faces of several dials approximately the amount of electricity used.

PATENT EXPIRED NOV. 5, 1889.

132,815. Improvement in Telegraph-Key; Almarian W. Decker, of Cleveland, O. By the use of this invention a special lever for breaking the circuit is avoided, as the one lever is used for telegraphing in the ordinary way, and by a side movement thereof the opening or closing of the circuit is effected without removing the hand from the lever, which must be done when two keys or levers are used.

Copies of the specifications and drawings complete of any of the patents mentioned in this record—or of any other patents issued since 1866—can be had for 25 cents. Give the date and number of patent desired, and address The W. J. Johnston Co. Ltd., Times Building, N. Y.